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An Overview of Alaska's Fisheries: Catch and Economic Importance of the Resources, Participants in the Fisheries, Revenues Generated, and Expenditures on Management

by

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Steve Cowper, Governor

The Fishery Research Bulletin Series was established in 1987, replacing the Informational Leaflet Series. This new series represents a change in name rather than substance. The series continues to be comprised of divisional publications in which completed studies or data sets have been compiled, analyzed, and interpreted consistent with current scientific standards and methodologies. While most reports in the series are highly technical and intended for use primarily by fishery professionals and technically oriented fishing industry representatives, some nontechnical or generalized reports of special importance and application may be included. Most data presented are final. Publications in this series have received several editorial reviews and usually two *blind* peer reviews refereed by the division's editor and have been determined to be consistent with the division's publication policies and standards.

AN OVERVIEW OF ALASKA'S FISHERIES: CATCH AND ECONOMIC IMPORTANCE OF THE RESOURCES, PARTICIPANTS IN THE FISHERIES, REVENUES GENERATED, AND EXPENDITURES ON MANAGEMENT[1]

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ABSTRACT

The year 1984 offered the most up-to-date and complete data on landings, personal income, and employment from commercial fishing in Alaska. In that year there were 30,000 harvesters and 19,000 others earned most of their personal income from in-state processing. Approximately 22,100 (74%) of the harvesters and 6,600 (35%) of the processing employees were Alaskan residents. Approximately $509 million was paid to fishermen for landings into Alaskan ports, and gross receipts paid to Alaskan seafood processors totalled $1.044 billion. The harvest and processing of these seafood products resulted in personal income of $583 million to all workers in the state or $431 million to Alaska residents. This included $239 million to harvesters (57% or $136 million to Alaskan residents), $104 million to processing employees (53% or $55 million to residents), $210 million to Alaska residents employed in indirect and induced activities (e.g., service industries, transportation, etc.), and approximately $30 million in taxes related to the commercial fishing industry. Excluded from these figures are $5-7 million in licenses and permits bought by fishermen, and an unknown portion of the revenues to the state's general fund that were generated directly or indirectly by commercial fishing from other assessments (e.g., corporate income taxes, business licenses, etc.). In 1984, the total direct, indirect and induced earnings from the commercial fishing industry totalled approximately 7% of the total personal income in Alaska or 27% of the total personal income generated by the private sector. Commercial fishing was most important to the southwest region of the state where it generated 47% of the total regional income or 98% of the total personal income by private basic sector activity. While data on personal income from the fishing industry are not yet available for 1985-86, it is known that gross receipts paid to both fishermen and processors have increased 50% from their 1984 levels to about $890 million and $1.6 billion, respectively, in 1986. Because of these increases in fishing activity and recent declines in both earnings of the oil industry and expenditures by state government, the estimated share of the state's economy held by the commercial fishing industry has undoubtedly increased since 1984.

Comprehensive studies of the economic impacts of sport fishing on total personal income and employment in Alaska are lacking. However, the information that is available indicates that these impacts are substantial and increasing each year. Sport-fishing effort has increased 62% from an estimated 1,198,486 angler-days in 1977 to 1,943,069 in 1985. The number of sport fishing licenses purchased in Alaska has doubled from 147,721 in 1975 to 303,802 in 1985. Recent estimates of expenditures associated with sport fishing are only available for Southcentral Alaska (Jones & Stokes Associates, Inc. 1987a) and the Juneau area (Jones & Stokes Associates, Inc. 1987b). Angler expenditures associated with sport fishing in Southcentral Alaska were approximately $127 million in 1986. Resident anglers contributed $74.2 million (58%) of the total. These expenditures resulted in approximately $65.3 million in personal income, and directly supported 2,178 sport fishing-related jobs which lead to an additional 662 jobs through indirect and induced effects in 1986. Angler expenditures associated with sport fishing in the Juneau area were estimated to be $14.4 million in 1986. This resulted in personal income of $6.7 million, and directly supported 182 jobs and another 114 jobs through indirect and induced effects in the Juneau area.

Unfortunately, estimates of statewide employment associated with sport fishing in Alaska are presently unavailable.

Further study of the economic (and other) value of subsistence fishing is also required to develop a fuller understanding of the roles of subsistence fishing in the Alaskan economy. Statewide, fish and shellfish account for about 65% (26.4 million lbs) of the total subsistence harvest (40 million lbs) taken from rural areas. The catch of salmon alone by subsistence fishermen in 1985 was approximately 1.2 million fish. However, evaluation of the economic impact of these subsistence harvests is very tenuous, because it is difficult to quantify the economic importance of the non-cash aspects of subsistence fishing. Despite these measurement difficulties, subsistence fishing is very valuable and, in fact, many communities would not exist without the non-commercial harvest of fish and game. Based upon replacement cost only, the minimum value of the subsistence salmon harvest on the Yukon River alone is estimated to exceed $16.8 million per year over the 1980-1984 period. However, the replacement cost significantly underestimates the total impact of the subsistence salmon harvest on the Yukon River, because the sociocultural value of these fisheries and other economic impacts are excluded from the calculation.

In fiscal year (FY) 1987 the estimated total expenditures of state of Alaska general funds on fisheries management will be $34.2 million for the Alaska Department of Fish and Game (ADF&G) and $45.2 million for all state agencies combined. ADF&G is funded at substantially lower levels than the other state fish and game agencies on the Pacific coast relative to the value of the commercial fisheries resources managed. Even excluding total economic benefits of sport, subsistence and commercial fishing to the Alaskan economy, fisheries management is a rather unique service provided by the state of Alaska, because of the comparability of fisheries management expenditures with revenues (taxes and licenses) returned to state's general fund through fishing activities.

Key Words: Commercial fisheries, sport fisheries, subsistence and personal use fisheries, catches, landings, ex-vessel value (gross receipts), economic impacts, economic base models, employment, participants, fishery revenues, expenditures on management, enhancement

INTRODUCTION

The purpose of this investigation was to present an overview of Alaska's commercial, subsistence and sport fisheries to facilitate effective fishery resource fiscal planning by the Alaska Department of Fish and Game (ADF&G) and state legislature. Data are presented on the catch, economic importance of the resources, participants in the fisheries, revenues generated, and costs of fisheries management to the state of Alaska. Emphasis is placed upon statewide summaries; presentation of region- or fishery-specific detail is beyond the scope of this document. Also, expenditures by the state on various fishery loan programs and revenues from interest payments on these loans are not treated in this report. Kreinheder and Teal (1982) and Berman and Hull (1987) provide some information about these loan programs.

While economic importance of fisheries in Alaska is included, it is important to realize from the start that our knowledge about the economic importance of the state's fisheries is rather limited. There are few studies dealing with economics of sport fisheries (e.g., Jones & Stokes Associates, Inc. 1987a,b, Sullivan and Sheridan 1981, USFW 1982, and McLean 1983) and subsistence fisheries (Robert Wolfe, ADF&G, Division of Subsistence, personal communication), but the total economic impacts of sport and subsistence fisheries on the Alaskan economy remain largely unknown. Also, there are a number of economic studies of particular commercial fisheries in Alaska (e.g., Butcher et al. 1981, Crutchfield et al. 1982, and Rogers and Mayer 1982) and at least two economic studies on the importance of Alaska's commercial fisheries from a statewide perspective (Kreinheder and Teal 1982, and Berman and Hull 1987). However, major difficiencies remain, including a thorough impact analysis of commercial fisheries on both the Alaskan and national economies. More specifically, some voids are: (1) the economic impacts of joint venture (JV) fisheries; (2) the changes in the economic importance of commercial fisheries to Alaska since 1984, especially with respect to substantial increases fishery yields and decreases in oil revenues; (3) detailed knowledge about the flow of seafood products and money through the state and out of state for each fishery; (4) information about the full economic value of commercial fisheries to fishermen, which may go beyond gross receipts to include boat storage, financing, food, fuel and other benefits that may be provided by processors (Crutchfield et al. 1982); and (5) information on expenditures in Alaska by both resident and non-resident employees in fish harvesting and processing.

CATCH AND ECONOMIC IMPORTANCE OF ALASKA FISHERIES PRODUCTS

Commercial Fisheries

Ex-Vessel Value (Gross Receipts)

Definition of "Value". The term "value" can have many different meanings. Here, **ex-vessel value** and **gross receipts to fishermen** are used synonymously to

refer to the total price paid to fishermen for fishery landings. The meaning of the term "ex-vessel value" diverges from the conventional economic meaning of this word, but it is consistent with common fisheries usage by non-economists. Consistent with typical economic usage, **value**, when used without a qualifier (such as "ex-vessel" or "social"), refers to gross receipts minus associated costs of production. It is a measure of the change in income associated with a change in the level of the fishery (Crutchfield et al. 1982).

Overview. The total ex-vessel value (gross receipts) of fish and shellfish landed into Alaskan ports has nearly tripled from $227 million corresponding to 616 million lbs in 1976 to $591 million representing more than 1.2 billion lbs in 1985 (Figure 1a,b, Table 1). On the other hand, the ex-vessel value of commercial fisheries harvests taken from Alaskan waters have increased nearly four-fold from $241 million in 1976 to $890 million (preliminary figure) in 1986 (Table 2). Gross receipts paid to fishermen have increased 50% from 1984 to 1986 alone. Even when these figures are adjusted for inflation using the Anchorage Consumer Price Index (CPI), the ex-vessel value (measured in 1986 dollars) of Alaska's commercial fisheries has doubled since 1976 (Figure 2b). The ex-vessel value reported here underestimates the total gross benefits transferred to fishermen to an unknown extent. Other economic values not accountable by gross receipts may include boat storage, financing, food, fuel and other benefits that may be provided by processors (Crutchfield et al. 1982).

The major species groups contributing to Alaska's commercial fisheries are salmon, shellfish (primarily crabs and shrimps), groundfish (mostly pollock, flatfishes and cods), halibut and herring (Figure 2a). The 1983-86 data in Figure 2a include joint-venture catches. In overview, since 1976 salmon have accounted for roughly 50% of the ex-vessel value. Shellfish have accounted for 40-45% until the early 1980's, when declines in several major shellfish fisheries occurred. Since the early 1980's groundfish landings have increased to account for nearly one-quarter of the ex-vessel value of commercial fishery harvests in Alaska. In 1986 salmon accounted for 46% of the total gross receipts to fishermen, groundfish amounted to 22%, shellfish were 21%, halibut were 7%, and herring were 4%.

Groundfish. From 1976 to 1985, commercial fisheries for groundfish (Table 3, Figure 3a) have contributed substantially toward the large increases in ex-vessel value of fishery landings into Alaskan ports. It is estimated that groundfish landings into Alaska amounted to only 1 million lbs in 1976. However, by 1985 this figure had grown to over 226 million lbs. In addition to landings in Alaskan ports, most of the catch of groundfish from joint venture fisheries off the Pacific coast (Table 3, Figure 3b) is taken in waters off Alaska. For example, in 1985 over 97% of the catch from joint venture fisheries were taken off Alaska. When the foreign catch of groundfish is included, the total catch of groundfish off Alaska in 1985 was 4.5 billion lbs (Table 4). In this year foreign fleets took 51% of the total catch of groundfish from waters off Alaska (Figure 4a). However, in 1987 all but 10% of the estimated optimal yield will be allocated to U.S. fishermen. Because of this change in allocation, further substantial growth of domestic groundfish fisheries in Alaska is anticipated.

Of the total commercial groundfish catch (by weight) in 1985, 73% were pollock (Table 5, Figure 4b). Flatfishes and Pacific cod accounted for 15.8% and 7.6%, respectively. A similar dominance of pollock in the catch was expected for 1987, in part because of anticipated continued growth of JV fisheries for pollock and the construction of several shore-based surimi plants in Alaska to process pollock.

Salmon. As with groundfish, the catch of salmon (Figure 5a, Table 6) has contributed significantly toward the large increases in value of fishery landings into Alaskan ports over the past decade. In fact, from 1973 to 1985 the landings of salmon into Alaskan ports have increased nearly seven fold from 22 million to 147 million fish.

In 1985 the 147 million salmon landed in Alaska by commercial fishermen (Table 6) weighed approximately 674 million lbs (ADF&G 1986b). Pink salmon accounted for 304 million lbs (45% by round weight), sockeye salmon equalled 225 million lbs (33%), and chum salmon weighed a total of 83 million lbs (12%). Coho and chinook salmon accounted for only 47 (12%) and 13 (2%) million lbs, respectively. In terms of numbers (or round weight) of salmon, the largest salmon fishery in the state was the pink salmon fishery in Southeast Alaska. A total of 52 million pink salmon (166 million lbs) were caught in Southeast Alaska, compared to a total of 24 million sockeye salmon (140 million lbs) in Bristol Bay. However, in terms of ex-vessel value, the Bristol Bay fishery was the most valuable salmon fishery ($122 million for all salmon species) in the state of Alaska in 1985.

Shellfish. Shellfish landings accounted for 21% of the total ex-vessel value of commercial fisheries harvests in Alaska for 1986. The $182 million in gross receipts paid to fishermen for shellfish in 1986 was the highest amount since 1982 (Table 2). Final figures are not yet available, but it is anticipated that the landings (in pounds) for 1986 were the highest since 1981 (Table 7). This recent increase largely represents steady growth of fisheries for brown king and Dungeness crabs, and 1986 openings for Bristol Bay king and Tanner crabs. Because many shellfish fisheries remain closed due to low stock sizes, significant potential for growth exists.

Impacts of Commercial Fishing on the Alaska Economy: Income

Introduction. **Economic impact** can be viewed as the answer to the question: "What is the economic activity generated by the use of the resource?" (Fay and Thomas 1986). Economic impact is usually evaluated in terms of both income (discussed in this section) and employment (see section on "Participation in Alaskan Fisheries"). Following the usage of Berman and Hull (1987), economic impacts of commercial fishing can be separated into **direct effects** (income and employment received in commercial fish harvesting), **indirect effects** (income and employment generated from business purchases by fishermen, value added by seafood processing, and business purchases made by processors), and **induced effects** (income and employment generated from the spending of income from direct and indirect effects). These induced effects include employment and income generated from building, repairing and maintaining vessels, selling merchandise to fishermen, air and ground transportation of both employees and products of the fishing industry, seafood advertising, marine fuel sales, and influences on many other sectors of the Alaska economy.

While evaluation of direct effects is largely an accounting problem, more sophisticated techniques are necessary to evaluate **secondary economic impacts** (indirect and induced effects). **Economic base models** and **input-output models** are two tools that economists use to evaluate these effects (Scott 1984). Economic base theory separates the economy into a **basic sector** (usually primary effects) and **non-basic sectors** (secondary impacts). Input-output models are more sophisticated techniques for evaluation of secondary impacts than economic base models.

Due to linkages between the Alaskan economy and the rest of the national economy, the total impact of Alaskan fisheries on the national economy (gain or loss of national income) and impact of fisheries on the Alaskan economy are not the same. Yet, little (e.g., Butcher et al. 1981) is known about the impacts of Alaskan fisheries on the economies of both Alaska and other states. Only impacts of commercial fishing on the Alaskan economy are discussed in this report.

Overview. In this document, the discussion of economic impacts will primarily focus upon the results of an economic base model developed for commercial fisheries in Alaska for 1984 by Berman and Hull (1987). For additional information, the reader is referred to their report, and two more-dated studies: Kreinheder and Teal (1982) or Rogers and Mayer (1982).

In 1984 a total of about $597 million was paid to fishermen for commercial fishery harvests from waters off Alaska (Table 2). Of this total, approximately $509 million were paid to fishermen for landings (1.0 billion lbs) into Alaskan ports (Table 1). The gross receipts paid to Alaskan seafood processors totalled $1.044 billion (ADF&G 1986a). The harvesting and processing of these seafood products resulted in a total of $583 million in personal income to workers in Alaska in 1984 (Berman and Hull 1987). This includes approximately $239 million to seafood harvesters (fishermen), $104 million to processing employees, $210 million to employees in indirect and induced activities, and approximately $30 million in taxes. Alaska residents accounted for approximately 74% ($431 million) of the total personal income earned by workers in Alaska from commercial fisheries. Non-residents accounted for $103 million of the harvesting income and $49 million of the processing income earned by workers in Alaska.

Data on the personal income earned by employees in other states as a result of commercial fishery harvests in Alaska are not available. Thus, these personal income figures (above) are indicative of the value of commercial fishing to the Alaskan economy only. In an analysis of the Alaskan shellfish fishery for the late 1970's using an input-output model, Butcher et al. (1981) found that increases in shellfish catch that caused $150 million in additional economic output to the Alaskan economy would also generate $95 million more output to the economy of Washington. While the economics of the shellfish industry in 1986 have undoubtedly changed since the late 1970's, these results do demonstrate that the total impact of Alaska commercial fisheries on the national economy can be substantially greater than their impact on the Alaska economy alone.

In 1984, the total direct, indirect and induced earnings from the commercial fishing industry totalled approximately 7% of the total personal income in

Alaska or 27% of the total personal income generated by the private sector (Berman and Hull 1987). Berman and Hull (1987) found substantial regional variation to exist. In the southwest region (Aleutian Islands, Bethel, Bristol Bay Borough, Dillingham, and the Wade Hampton Census Area) commercial fishing generated 47% of the total regional income and 98% of the total personal income by private basic sector activity. In Southeast Alaska, the fishing industry contributed 10% of total personal income or 40% of private sector income. In the gulf coast region (Kenai Peninsula Burrough, Kodiak Island Burrough and the Valdez-Cordova Census Area) the fishing industry constituted 19% of total personal income and 44% of private sector income. In the northern region (area from the Yukon-Kuskokwim Delta northward along the coast) earnings from commercial fishing were largely masked by activity of the North Slope oil industry, but still contributed 5% of the income generated from the private sector in this region. Even in Anchorage and the Matanuska-Susitna Borough, the commercial fishing industry comprised 2% of the regional income or 9% of private basic income from indirect and induced effects.

Information about the economic impact of the commercial fishing industry in Alaska is not available for 1985 and 1986. Berman and Hull (1987) state that "Since earnings in fishing have increased and earnings in the oil industry have declined during the past two years, the estimated share [of the Alaskan economy] for fisheries for a more recent period--if the data were available--would undoubtedly be higher". We do know that gross receipts to fishermen increased 50% from $597 million in 1984 to $890 million in 1986 (Table 2). Gross receipts to Alaskan processors similarly increased 50% from $1.044 billion in 1984 to approximately $1.6 billion in 1986. Yet we cannot estimate total impact of commercial fisheries on the Alaskan economy in 1986 using Berman and Hull's (1987) model nor the impact of these gross receipts on 1986 harvesting and processing because of: (1) a relative lack of predictive power associated with economic base models (Scott 1984), and (2) recent structural changes in the Alaskan economy and fishing industry for which we lack data (see Berman and Hull 1987, and comments in the "Introduction" of this report). Structural changes are expected to be associated with the 50% increase in ex-vessel value of landings, the 100% in landings from joint venture fisheries for 1983-1985 (Table 3), and with changes in the relative importance of particular fisheries (Table 2, Figure 2a) and their associated seafood products.

Sport Fisheries

Sport fishermen catch a wide variety of species of fish and shellfish (Table 8). By number the greatest sport catches for 1985 were razor clams (1,206,660), smelt (334,775), sea-run coho salmon (200,997), and rainbow trout (193,027). Over 1977 to 1985 the largest increases in catch (in numbers) were associated with halibut (450%), whitefish (350%), burbot (223%) and chum salmon (123%). Over 1976-84, the total sport catch of all salmon tripled from 201,000 to 626,000 (Figure 5b, Table 9).

Determination of the value of sport fishing in the economy is less straightforward than for commercial fishing. Valuation of sport fisheries often involves estimates of market values such as expenditures and nonmarket values

such as consumer surplus benefits, willingness to pay, and existence values (see McLean 1983 for discussion). Detailed discussion of these valuations is well beyond the scope of this document. Even so, knowledge about economic impact of sport fisheries in Alaska is quite limited. Studies completed to date on valuation of sport fisheries on a statewide (USFW 1982) or regional basis (Jones & Stokes Associates, Inc. 1987a,b, McLean 1983, and Sullivan and Sheridan 1981) offer only partial insight into the economic impact of sport fishing in Alaska. These studies are discussed briefly here.

Sullivan and Sheridan (1981) estimated the value of sport fishing in the Tongass and Chugach National Forests to be $6.7 million in 1979. However, in their study, value was approximated not by expenditures but rather by an estimate of the angler's willingness to pay for the right to fish over and above the current cost of participation. Sullivan and Sheridan (1981) cautioned that this value is only an index and should not be considered to be equivalent to economic values from commodity outputs.

As part of a national survey (USFW 1982), 780 sportsmen were interviewed to estimate expenditures on hunting and fishing in Alaska. Results showed that primary expenditures included transportation, food, lodging, and equipment. Total expenditures were estimated as travel-related expenditures of residents and nonresidents, and equipment and other expenditures of residents only. Total expenditures on sport fishing within the state of Alaska for 1980 were estimated to be $57.2 million, or $255 per year per angler (see Table 23 in USFW 1982). Of this total, approximately $24.5 million was spent by non-residents in Alaska. McLean (1983) estimated total expenditures of $9.6 million by sport fishermen in the Tanana Basin alone in 1981.

The expenditures in USFW (1982) cannot be used to directly estimate the current value or impacts of sport fishing to the Alaskan economy for two reasons. Firstly, expenditures do not consider primary or secondary economic impacts on personal income. Secondly, there are some discrepancies in some of the tables presented and there are independent data to suggest that these estimates of expenditures may be underestimated (L. Bandirola, Alaska Department of Fish and Game, Juneau, personal communication). Lastly, the sport fishing industry has developed more fully since 1980, as evidenced by a 47% increase in license sales through 1985. Increasing value of sport fishing in Alaska is strongly indicated by effort, measured in angler-days (P. Krasnowski, Alaska Department of Fish and Game, Anchorage, personal communication). Sport fishing effort has increased 62% from an estimated 1,198,486 angler-days in 1977 to 1,943,069 in 1985. Economic impact of sport fishing in Alaska may be more closely tied to effort than catch, because catch is affected by both fishing effort and fish abundance. In addition, increases in the number of catch-and-release activities in Alaska are not reflected in catch data alone.

More recent estimates of expenditures associated with sport fishing are only available for Southcentral Alaska (Jones & Stokes Associates, Inc. 1987a) and the Juneau area (Jones & Stokes Associates, Inc. 1987b). Angler expenditures associated with sport fishing in Southcentral Alaska were approximately $127 million in 1986. Resident anglers contributed $74.2 million (58%) of the total or $866 by the average sport fishing household (2.9 family members). These expenditures resulted in approximately $65.3 million in personal income.

The average sport fishing household (2.7 family members) for Juneau area residents spent $1,647 on sport fishing in Alaska. Total angler expenditures associated with sport fishing in the Juneau area were estimated to be $14.4 million in 1986. This resulted in personal income of $6.7 million in the Juneau area.

Subsistence and Personal Use Fisheries

Subsistence hunting and fishing is permitted in rural Alaska in cases of customary or traditional use. Subsistence harvests can be used as barter, but may not be sold. Approximately 47.4 million lbs of fish and game resources are harvested annually in Alaska by subsistence hunters and fishermen (R. Wolfe, Alaska Department of Fish and Game, Juneau, personal communication). Of this total, approximately 40 million lbs are harvested in rural areas. Fish (primarily salmon, halibut, herring, whitefish, Arctic char, and Dolly Varden) comprise the largest portion of the subsistence harvest (in weight) in all areas of the state, except the Arctic, where marine mammals are of greater importance (ADF&G 1986c). Statewide, fish account for about 65% (26.4 million lbs) of the rural subsistence harvest. The catch of salmon alone by subsistence fishermen in 1985 was approximately 1.2 million fish (Figure 6a, Table 10). These harvest figures should be considered approximate only; due to widespread non-reporting and undersampling, subsistence harvest levels are typically underestimated (ADF&G 1986c).

It is very difficult to evaluate the economic impact of subsistence fishing in Alaska. The field of "economics" deals almost exclusively with cash-based economies. Yet, fish and game are harvested by subsistence users to provide food for the family or social group, rather than to provide income through sales in the marketplace (ADF&G 1986c). In addition to the food value, it is difficult to quantify the economic importance of other non-cash aspects of subsistence fishing, including social, cultural, and religious values associated with the harvests. In some communities of Alaska, the sociocultural value of the harvesting activity itself may exceed any economic value of the product. Despite these measurement difficulties, the fact is that many communities would not exist without the non-commercial harvest of fish and game (R. Wolfe, Alaska Department of Fish and Game, personal communication).

The minimum value of the subsistence salmon harvest on the Yukon River alone is estimated to exceed $16.8 million per year over the 1980-1984 period (R. Wolfe, Alaska Department of Fish and Game, personal communication). This estimate is based only upon replacement cost, which is the cost of replacing the salmon harvest with imported red meat, fish and poultry of equal protein content. Among other assumptions, this estimate assumes that these imported meats would actually be acceptable substitutes to the subsistence fishermen, and that the infrastructure exists to actually deliver and dispense the food. The replacement cost underestimates the true importance of the subsistence salmon harvest on the Yukon River, because the sociocultural value is excluded from the calculation. Secondary economic impacts are also ignored.

The average annual subsistence harvest of salmon from the Yukon River over 1980-1984 was 368,421 fish, or approximately 31% of the 1.2 million salmon harvested annually by subsistence fishermen statewide. However, it would be inappropriate to generalize from the replacement cost of salmon caught by subsistence fishermen on the Yukon River to replacement cost of salmon statewide, because the mix of subsistence and cash-based economies in subsistence communities varies widely throughout the state (Wolfe and Walker 1985, and ADF&G 1986c). Further study of the economic (and other) value of subsistence fishing is necessary to develop a fuller understanding of the roles of subsistence fishing in the Alaskan economy.

Personal use fisheries differ from susbsistence fisheries in that catches may not be used for trade. They also differ from sport fisheries, because gear not legal for sport use and catches in excess of those permitted by sport fishing are often allowed. Personal use fisheries are fairly significant only in Prince William Sound and Cook Inlet. For example, in 1984, approximately 49,940 salmon were taken by the personal use fishery in Prince William Sound. Other data on personal use catches are difficult to locate, and difficult to separate from subsistence catches.

LANDINGS FROM FISHERIES OFF ALASKA COMPARED TO WASHINGTON, OREGON AND CALIFORNIA

Commercial Fisheries

The ex-vessel value (gross receipts) of Alaska's commercial fishing industry ranks first among all states. The ex-vessel value of fishery landings in Alaska is more than twice the landed values of Washington, Oregon and California combined (Table 1, Figure 1b). From trends in these landing statistics (Figure 1a,b) and projected phase-out of foreign catch in Alaskan waters, it is expected that fishery products from Alaska fisheries will become even more valuable relative to these other states in the near future.

The landings data of Table 1 are somewhat deceiving in that they do not indicate the location of the catch. The actual catch from fisheries in Alaska is larger than landings in Alaska, because a significant amount of Washington landings include catches from Alaskan waters.

Commercial landings into Alaskan ports greatly exceed those for other west coast states for all of the major species groups: groundfish (Table 3, Figure 3a), salmon (Table 6, Figure 5a), and shellfish (Table 7). Groundfish landings to domestic processors in Alaska approximately equal the landings in all of the other Pacific coast states in 1985 (part of which were caught off Alaska). Furthermore, when the JV catch of groundfish from Alaskan waters is included, Alaska's 1985 catch of groundfish exceeds the sum of the landings of the other Pacific states combined by nine fold. This figure even excludes the 1985 groundfish catch off Alaska by foreign fleets (Table 4). For salmon, Alaska's catch (in numbers) exceeded the other Pacific states by more than 14 times (Table 6), and landings (in weight) of shellfish into Alaskan ports

exceeded the sum of the landings into the other west coast states by three fold in 1985 (Table 7). Over the past decade (1976-1985), 74-81% of all annual west coast shellfish were landed in Alaska.

Sport Fisheries

Since 1976 the total catch of salmon by sport fishermen has declined in all Pacific coast states, except Alaska (Table 9, Figure 5b). The sport catch in Alaska has more than tripled over this period. In 1984 the sport catch of salmon in Alaska equalled 626,000 fish, which even exceeded the commercial catch in Oregon and California combined for the same year. The catches of other species of sport fishes besides salmon were not readily available for all Pacific coast states and are not treated in this report.

PARTICIPATION IN FISHERIES IN WATERS OFF ALASKA

Impact of Commercial Fisheries on the Alaska Economy: Employment

Overview

Commercial fishing activity stimulates employment in fish harvesting, seafood processing, and other sectors of the economy, including vessel repair, fuel sales, sales of supplies, and transportation of fish to processors, distributors or cold storage facilities (Berman and Hull 1987). Estimation of employment associated with the commercial fishing industry is very difficult, due to two fundamental problems: (1) unresolved questions about the most meaningful statistics to be estimated; and (2) a lack of good data.

For the commercial fishing industry, three statistics on employment are often presented: annual average employment, peak monthly employment, and number of employees or participants. **Employment** is the number of filled positions at a particular time (Jensvold et al. 1987). **Peak monthly employment** is the greatest number of filled positions in any one month of the year. **Annual average employment** is calculated as the sum of the estimated monthly employment for the year, divided by twelve (Focht 1986). Annual average employment is a useful statistic for many sectors of the economy. But for the fishing industry (particularly fish harvesting) it is not clear that it is the most appropriate employment statistic, because it ignores the fact that it may not require twelve months of fishing for each fisherman to earn a respectible annual salary. Finally, the number of **employees** (Jensvold et al. 1987) or **participants** (Focht 1986) is the number of individuals (unduplicated count) employed during a particular time period.

Good data on employment in the commercial fishing industry are not easily obtainable. One difficulty is the exclusion of fish harvesting employment from Alaska Department of Labor (ADL) monthly survey statistics on employment in nonagricultural industries, because fish harvesting is classified as an agricultural industry and not sampled by ADL (Focht 1986). Additionally, the

use of statistics from the unemployment insurance program are not applicable to fish harvesting (unlike many other industries), because many gear operators are self-employed and not covered by this program (Focht 1986). Another difficulty is that employment in seafood processing is often not separated from food processing in ADL reports, although most of the food processing employment is associated with seafood (B. Jensvold, Alaska Department of Labor, Juneau, personal communication). Because some statistics on employment are obtained for the 12th of every month, employment in some fisheries is missed entirely due to the high degree of seasonality inherent in many fisheries (Focht 1986). Errors from this source could lead to underestimation of the peak monthly employment.

As for sectors of the economy other than fish harvesting and processing, the only information about employment resulting from commercial fishing are derived from **economic multipliers** for employment. The product of these multipliers and employment figures for harvesting and processing yields an estimate of employment in other areas of the economy as a result of commercial fishing. Estimates can be generated from economic base models (e.g., Kreinheder and Teal 1982), but it should be realized that confidence in them is low due to lack of good data (Berman and Hull 1987).

Data on employees or participants in fishing are also problematic. Some information can be obtained from the ADF&G's fish ticket system, but participants in joint venture fisheries are excluded from the data (Focht 1986). Yet, JV fisheries are now dominating groundfish catches from Alaskan waters (Table 3, 4). Additional information on employees (as opposed to employment) were obtained by Jensvold et al. (1987) by crossmatching data from the Alaska Department of Labor with records from the permanent fund dividend program. Employees are counted in the industry for which they earned the most wages during the year. While this is a good approach for comparisions of employees among different industries, the actual number of unique employees earning some wages in fish processing will be underestimated by this method.

Harvesters

Excluding vessels in the Arctic-Yukon-Kuskokwim (AYK) region, there were 15,839 vessels licensed to fish commercially in Alaska in 1986 (Table 11, Figure 7). Of these, 11,062 (70%) were registered by Alaska residents, 2,674 by non-residents, and 2,103 by individuals of unknown residency. The total number of vessel licenses represents only a 9% increase since 1978.

In 1986 there were also 28,663 fishing permits purchased (Table 12, Figure 8). Of these 84% (24,059) were purchased by residents; the remainder (4,604) were purchased by non-residents. These permits were purchased by 17,340 individuals, 81% (14,024) of whom were Alaska residents and the remainder (3,316) were non-residents (Table 13, Figure 9). The number of permits purchased for commercial fishing and the number of individuals purchasing permits has increased 53% and 45%, respectively, since 1974. Also, in 1986, there were 29,904 licenses sold to crew members for participation in commercial fisheries in Alaska; 67% of these were purchased by Alaska residents (Table 14, Figure 10).

For reasons beyond the scope of this report, it is difficult to simply add data on fishing permits and crew member licenses to estimate the number of participants in fish harvesting. However, unofficial estimates, which account for some of these problems, are available for 1977-84 (Focht 1986) as listed in the Table 15. These figures show a 13.5% and 32.9% rise in total participation from 1977 to 1984 or from 1977-83, respectively. The rise and collapse of crab fisheries in western Alaska, which have been dominated by nonresidents, can account for some of the fluctuations (Focht 1986). Over 1977-1984 participants from Washington have averaged 15.7-18.6% of the total. Oregon and California participants average 2.0-2.7% each.

At present, official estimates of fish harvesting employment (number of filled positions) are available only through 1983 (Berman and Hull 1987). For that year, peak monthly employment was 26,000. Also in 1983, the average annual employment in fish harvesting was roughly 8,000. Of this total, approximately 6,300 (79%) were Alaska residents and 1,600 were nonresidents. Annual average employment was 5,000 in salmon fisheries, 1,400 in shellfish fisheries, and 1,000 in fisheries for halibut.

Processors

Growth of commercial fishing in Alaska over the past decade is also revealed by the number of fish processing facilities. Since 1976 the number of fish processing facilities has more than tripled to 629 in 1985 (Table 16, Figure 11a). The large increase in the number of floating processing vessels has accounted for a major portion of this growth. In 1986 these processing plants were owned by 442 companies, which is nearly a three-fold increase over 1976, as well (Table 16).

It has been estimated that the number of employees in food processing (primarily seafood processing) equalled 18,683 in 1984 and 19,943 in 1985 (Jensvold et al. 1987). Of these totals, 12,068 (65%) and 13,512 (68%) were nonresidents in 1984 and 1985, respectively. In this case, employees were defined as the number of individual people who worked in seafood processing and received most of their annual wages in this industry. Those who worked in seafood processing, but earned more wages in another sector of the economy, were excluded from these counts. Thus, for 1984 there were approximately 48,287 employees in fish harvesting and processing combined. Approximately 28,738 of these employees were Alaska residents. Participation in fish harvesting and processing for 1986 is expected to be larger than for 1984, due to the growth in the fishing industry over this two-year period revealed by the 50% increase in ex-vessel value (Table 2).

Over 1977 through 1985 the average annual employment in seafood processing has been between 5,500-8,000 (K. Thomas, Alaska Department of Labor, Juneau, personal communication). The annual average employment in seafood processing for 1983 was 6,327. Thus, there was an average employment of about 14,300 in harvesting and processing for each month of 1983. We were unable to determine the proportions of Alaska residents and nonresidents from this total, because the employment data for processing have not been disaggregated in this way. Also, similar totals for 1984-86 could not be computed, because harvesting employment figures are currently unavailable for these years.

Peak monthly employment provides yet another indicator of seafood processing employment. Employment in fish processing has nearly tripled since 1976 (Table 16, Figure 11b) to include 31,224 jobs during the peak month of employment for 1985. It should be pointed out that these data differ from other data compiled independently from other sources by the Alaska Department of Labor (see Table 9 in Berman and Hull 1987).

Other Sectors of the Economy

As described above, little data exists on employment in sectors of the economy other than fish harvesting or processing. As with personal income, estimates of employment in these other sectors can be generated, but they would be much less accurate than the personal income estimates (Berman and Hull 1987). Berman and Hull will be generating some estimates of employment shortly. In an older study which used a computer model of the Alaskan economy for 1979, Kreinheder and Teal (1982) estimated that for each 100 additional jobs in the fish processing industry, another 28 were induced in other sectors of the economy. This employment effect of seafood processing should be treated cautiously because of concerns raised by Berman and Hull (1987) and the fact that the Alaskan economy (and fishing industry) has changed significantly since 1979. If Kreinheder and Teal's findings are still reasonably valid, most of the additional jobs would occur in the service industry (54%), transportation (16%), and government (13%).

Sport Fisheries

The number of sport fishing licenses purchased in Alaska has doubled from 147,721 in 1975 to 303,802 in 1985 (Table 17). Approximately 58% of the licenses were sold to Alaska residents in 1985. The 127,077 non-residents who purchased sport fishing licenses generated economic activity within the Alaskan economy in terms of revenues from license sales and income from transportation, services, sale of merchandise, etc. Jones & Stokes Associates, Inc. (1987a) found that angler expenditures in Southcentral Alaska directly supported 2,178 sport fishing-related jobs and supported an additional 662 jobs through indirect and induced effects in 1986. Also in 1986 Juneau area sport fishing directly supported 182 jobs and another 114 through indirect and induced effects (Jones & Stokes Associates, Inc. 1987b). Unfortunately, estimates of statewide employment associated with sport fishing in Alaska are presently unavailable.

Subsistence and Personal Use Fisheries

Data on participation in subsistence fishing in Alaska are limited. The best participation data exists in subsistence salmon fisheries regulated by permits that require end-of-season catch reports to be returned to ADF&G. Yet, permits are not issued for Kotzebue, Port Clarence, Norton Sound, Yukon, Kuskokwim and the Aleutian Islands; substantial catch of salmon is taken in these districts. However, other estimates of the number of family units

participating in subsistence salmon fishing in these areas are available. Using all these estimates, the number of families participating in subsistence salmon fishing has nearly tripled from 5,438 in 1970 to 14,472 in 1985 (Table 10, Figure 6b). Because a number of family members may fish using one permit, the number of individual participants exceeds these figures.

We did not have ready access to data on the participation in personal use fishing, but we do know that the number of individuals involved is insignificant relative to participation in commercial, sport and subsistence fishing, except in Cook Inlet where nearly all of the shellfish harvest is for personal use rather than subsistence.

REVENUES DERIVED FROM USERS OF FISHERIES RESOURCES

Aside from the ex-vessel and first wholesale values of Alaska's fisheries and the economic activity (in terms of employment and personal income) generated from them, fishing generates revenues directly to the state of Alaska from taxes and licenses (Table 18, Figure 12b). In FY-86 revenues generated to the state from fisheries equalled $47.3 million, of which $43.4 million went to the general fund and $3.9 million went to the fish and game fund. We have excluded revenues from hunting and trapping sources (e.g. license sales) from these figures. Fishery revenues include fish taxes, marine fuel taxes, fishing permits, fishing licenses and other similar items. The revenues in 1986 represent an increase of nearly 3.5 fold over the same figures for 1977. Even when corrected for inflation, revenues from these sources have doubled over this nine-year period (Figure 12a).

For comparison with fishery management expenditures, we have removed two items from the total fishery revenues to the general fund: revenues dedicated to the private nonprofit organizations (e.g. salmon enhancement tax was $4.3 million for FY-86), and revenues received from federal sources ($6.6 million in FY-86). Actually, we could find reasons to both leave these revenues in our total or exclude them from our total. Namely, collection of salmon enhancement taxes helps to fund aquacultural associations and does not represent unrestricted revenue to the state. On the other hand, it does represent revenues from fishery resources which ADF&G manage. For revenues from federal sources, one could argue that these are not truly "revenues" and should not be included in fishery revenues. However, some of these federal monies come from Alaska's share of Dingell-Johnson funds, which are derived from an excise tax on recreational fishing equipment used in sport fisheries which ADF&G manage. In any case, fishery revenues, excluding revenues from these two sources, total $36.5 million for FY-86.

Beyond these revenues, an unknown portion of the $55.4 million in revenues to the general fund generated from non-petroleum corporate income taxes, non-mining business licenses, and aviation and highway fuel taxes in FY-86 (Wright 1987) directly or indirectly resulted from fishing in Alaska. Undoubtedly, a significant portion of this total can be attributed to the commercial and sport fishing activity, but we have made no attempt to estimate the contribution of fisheries toward these revenues.

COSTS OF MANAGING FISHERIES RESOURCES

Alaska

Total Cost to the State of Alaska

The total cost of managing commercial fisheries in Alaska for FY-87 was calculated by adding together the estimated portions of the budgets of ADF&G and several other state departments which are associated with fisheries management (Table 19). Because many divisions and departments have multiple functions, it was difficult to separate costs associated with management of fisheries alone. Best estimates of the costs associated with fisheries were determined through discussions with knowledgeable staff in each department (Table 20). In each case the figures listed in Table 19 represent 100% of the respective budgets, except for ADF&G (percentages to be discussed in detail below), Office of International Trade (10%) and Fish and Wildlife Protection (65%).

As might be expected, the greatest general fund expenditures on fisheries management are associated with ADF&G ($34.2 million), followed by the Department of Public Safety ($7.5 million), and the Department of Commerce and Economic Development ($2.1 million). The estimated total expenditures for all departments in FY-87 was $45.2 million from general funds or $64.3 million from all funding sources combined. When expenditures on Sea Grant and the Marine Advisory Program of the University of Alaska are added, the totals come to $46.3 million (general funds) and $67.0 million (all funds). As a basis for comparison, approximately 1.6% of the total $2.145 billion in anticipated (restricted) general fund expenditures by the state of Alaska for FY-87 went toward fisheries management activities by ADF&G. The estimated general fund expenditures on fisheries management of all departments in FY-87 was 2.1% of the state total or 2.2%, when Sea Grant and Marine Advisory Programs expenditures of Table 19 are included.

Alaska Department of Fish and Game

Overview. Expenditures on fisheries management by the Alaska Department of Fish and Game were determined by summing the approximate expenditure from each division which was associated with fisheries. The estimated general fund appropriations expended on fisheries management cost for each division for FY-87 is listed in Table 21 (also see Table 19). In some cases this was difficult to do accurately, because some divisions perform both fisheries and game functions.

Total general fund expenditures by ADF&G on fisheries management were estimated for FY-76 through FY-87 (Table 22, Figure 13) using historical budget data and the same percentages used in Table 21. General fund expenditures were $11.8 million in FY-76, peaked at $43.0 million in FY-85, and declined to $34.2 million in FY-87. When these expenditures are adjusted for inflation using the Anchorage consumer price index, it can be shown that the FY-87 funding level is below the FY-81 level (Table 23, Figure 13). While actual funding of fisheries activities by ADF&G has increased 2.9 times from

FY-76 to FY-87 (Table 22), the increase in real (inflation-adjusted) dollars has been only 1.6 times (Table 23).

Division of Commercial Fisheries. Because the Vessels Section was incorporated into the Division of Commercial Fisheries only recently, two sets of data are presented: the Division of Commercial Fisheries and Vessels separately (Table 24, Figure 14), and the Division of Commercial Fisheries including the Vessels Section (Table 25). Actual expenditures (both from general funds and from all sources) by the Division of Commercial Fisheries have increased 2.6 times from FY-76 through FY-87, whether or not Vessel expenditures are included. When actual expenditures are adjusted by the inflation rate (Anchorage consumer price index) relative to 1976, expenditures have increased much less (Table 26, Figure 14). From FY-76 to FY-87, the Division of Commercial Fisheries budget (excluding Vessels) has increased only 52% (or 1.52 times), while the Vessels Section has actually declined 12%. If FY-78 is chosen as the base year, the Division of Commercial Fisheries budget has increased only 23% and Vessels has decreased 34%.

Division of FRED. Total expenditures by the Division of Fisheries Rehabilitation, Enhancement and Development (FRED) increased 3.5 fold from FY-76 through FY-86, then declined 5% to a total budget of $15.2 million in FY-87 (Table 27). On the other hand, expenditures of general funds increased 3.2 fold from FY-76 through FY-85, and then declined 19% through FY-87 (Table 27, Figure 15a). When general fund expenditures are adjusted for inflation, increases in spending are modest. Inflation-adjusted expenditures from general funds increased 45% from FY-76 to FY-87 (Table 26).

Division of Sport Fisheries. The total budget of the Division of Sport Fisheries increased 5.5 fold from $2.3 million in FY-76 to $12.9 million in FY-86, and declined 37% to $8.2 million in FY-87 (Table 28). General funds never played an important role in the budget for this Division. General funding peaked at $1.0 million in FY-85 and declined to zero in FY-87. In dollars adjusted for inflation relative to 1976, general funding for the Division of Sport Fisheries peaked at only $610,000 in FY-85 (Table 26, Figure 15b). In FY-87 approximately 56.5% ($4.6 million) of the budget for the Division of Sport Fisheries came from federal funds, 43% ($3.5 million) from the Fish and Game Fund and 0.5% ($0.05 million) from other sources.

Washington, Oregon and California

For comparative purposes, recent budget data from the Washington Department of Fisheries (WDF), Washington Department of Game (WDG), Oregon Department of Fish and Wildlife (ODFW), and California Department of Fish and Game (CDFG) were acquired. Fundings for WDF, WDG and ODFW are appropriated on a two-year (biennium) basis. To make these figures comparable with the annual budget statistics for ADF&G and CDFG, their annual budgets were estimated as one half of their two-year budgets. Also, the average of FY-86 and FY-87 budgets for ADF&G was computed to most fairly represent annual funding over accounting periods similar to the other states. Total budgets of these state management agencies are presented in Table 29. The largest annual budget for state fish and game agencies belongs to California ($106.6 million), followed by Alaska

($75.6 million, the average for FY-86 and FY-87), then Washington ($59.8 million) and Oregon ($50.0 million). Representatives from WDF, WDG, ODFW and CDFG all indicated that their budgets were anticipated to increase slightly (keep pace with or exceed the inflation rate) for the next appropriation period.

An interesting feature of these budget statistics is that all other Pacific coast states receive much greater levels of dedicated funding from license sales and fish taxes than in Alaska (Table 29, Figure 16). Only 10% of ADF&G's budget is derived directly from these sources (Fish and Game Fund), while Washington, Oregon and California receive 31%, 43%, and 51%, respectively, of their budgets from these sources. Revenues from license sales constitute the largest percentage of these funds earmarked for the other fish and game agencies.

Using data provided by the fish and game management agencies for the Pacific coast states, expenditures that these agencies devote to fisheries management were estimated separately. To do so, first dedicated fisheries expenditures were separated from dedicated wildlife (or game) expenditures. Then other expenditures (e.g. administration, capital improvements, etc.) were assumed to be apportioned based upon the relative magnitudes of the dedicated fisheries or wildlife costs. Also, the general fund, federal funds and the contribution of other funds were assumed to be apportioned based on the overall contribution of these funding sources toward the overall budget. In the case of ADF&G we had good data on the breakdown, so fewer assumptions had to be made. For ADF&G the same percentages of each division's budget were used as in Table 21.

The relative order of states based on funding for fisheries management (Table 30) was similar to the order based on overall funding of state fish and game management agencies (Table 29). Again, California spent the greatest amount annually on fisheries management ($68.5 million), followed by Alaska ($54.2 million for the average of FY-86 and FY-87), Washington ($47.7 million), and Oregon ($38.3 million). The current (FY-87) funding level (from all funding sources) for fisheries management by ADF&G is $50.9 million. As with total fish and game agency budgets, fisheries management funding for all other state management agencies on the Pacific coast are expected to increase to slightly for their next appropriation period. Given an expected 3% increase in Washington for FY-87 to FY-89, decreases in expenditures more than 3.5% in Alaska would place ADF&G in third place (behind CDFG and WDF/WDG) for funding of fisheries management activities on the Pacific coast.

CONTRAST BETWEEN SOME BENEFITS FROM FISHERIES AND EXPENDITURES ON MANAGEMENT WITH REFERENCE TO OTHER PACIFIC COAST STATES

Revenues from Fisheries vs. Expenditures on Management

The $45.2 million in fishery expenditures by all Alaska departments for FY-87 (Table 19) cannot be directly compared with the Alaska fishery revenues from

FY-86 (Table 18). Fisheries revenues in FY-87 are expected to exceed those in FY-86. In fact, fisheries revenues for FY-86 exceeded fishery revenues for FY-85 by $6.4 million.

Lacking access to historical fishery expenditures for each department in Alaska, we were unable to directly compare general fund expenditures on fisheries management by the state of Alaska with annual fishery revenue data provided by the Department of Revenue. However, we could compare ADF&G expenditures with these revenues, as long as it is recognized that non-ADF&G expenditures from the general fund are not included. For FY-87, ADF&G expenditures were roughly 75% of the total general fund expenditures on fishery management.

We plotted general fund expenditures by ADF&G on fisheries management activities and total fisheries revenues (Figure 17) separately for FY-77 through FY-87. To facilitate comparison of funding levels of past years with current levels of funding, all values are presented in 1986 dollars (adjusted for inflation using the Anchorage Consumer Price Index). Expenditures include the estimated general fund expenditures by ADF&G on fisheries management activities. Revenues are taken to include total fisheries revenues minus the salmon enhancement tax, federal sources of revenue (e.g. Dingell-Johnson funds) and the Fish and Game Fund (see last column in Table 18). For fair comparison between revenues and expenditures we excluded these three sources of revenue from the total, because they were not deposited into the state's general fund for unrestricted use for expenditures.
Figure 17 can be used to demonstrate that fishery management costs to the state are recovered for the most part in the form of revenues. For FY-86, approximately 77% of the general fund expenditures by ADF&G were recovered in the form of revenues to the state's general fund. Fisheries management is a rather unique government service with respect to this comparability of the magnitude of state fishery revenues and expenditures on fishery management in Alaska.

Value of Fisheries vs. Expenditures on Management

We plotted the percentage of the state's general fund expenditures (in 1986 dollars) on fishery management by ADF&G for FY-71 through FY-86 (Figure 18). The percentage of the state's operating budget spent on management activities by ADF&G has declined over this time period (in terms of 1986 dollars), despite increases in revenues generated (Figure 17), peak number of employees in fish processing (nearly tripled since 1976), number of processing plants (more than tripled since 1976), value of the fisheries (increased eight fold since 1967 - even in 1986 dollars, Figure 19), increased complexity of fishery management problems, and requirements for state representation in new federal (e.g. North Pacific Fishery Management Council, Arctic Research Commission) and international (e.g. Pacific Salmon Commission) management agencies.

We compared the value of fisheries relative to expenditures on management. Of course, this is very difficult to do without detailed knowledge about the values of commercial, sport, subsistence and personal use fisheries in terms of direct, indirect and induced impacts. Such detail is not available. As a

partial indicator of value, we chose to examine ex-vessel value from commercial fisheries prosecuted in Alaskan waters. Ex-vessel value has increased nearly eight fold since 1967, even when values are adjusted to 1986 dollars (Figure 19). On the other hand the ratio of the general fund expenditures on fishery management by ADF&G to ex-vessel value has generally declined from 9% during the early 1970's to approximately 3% in 1986 (Figure 19a). That is, $0.03 are spent on fishery management by ADF&G for every $1.00 in ex-vessel value, or 1.7 cents for each first wholesale dollar.

We also examined the FY-86 general fund expenditures for fishery management for each state fish and game agency on the Pacific coast from Table 30 with the ex-vessel values of resources landed into each state from Tables 1 and 2 (Figure 20). The expenditure and value data are not completely comparable for several reasons: (1) ex-vessel values correspond to the state in which the landing took place; for example, fish and shellfish caught in Alaska but landed in Washington are recorded with Washington's landings; (2) the data include some landings from fisheries which the state's do not manage; for example, tuna landed into California are added to California's landings, and halibut and other groundfish are included in Alaska's landings, although neither California Department of Fish and Game nor Alaska Department of Fish and Game manage these species; and (3) these data include sport fishery management costs, but exclude the values of non-commercial fisheries. Accepting these qualifiers, the plot does show that ADF&G is funded at substantially lower levels than other state fish and game agencies on the Pacific coast relative to the value of commercial fishery resources that they manage. Approximately 7.6% of the value of marine fisheries off Alaska is spent on fisheries management in Alaska compared to 51.3% for Washington, 83.4% for Oregon and 51.5% for California. In addition, ADF&G manages fisheries along a coastline that is longer than the coastlines of all other 49 states combined.

Finally, it should be pointed out that the oil industry is expected to continue to play a diminishing role in the economy of the state of Alaska. This decline, coupled with continued increases in the both value of fishery resources and fishery revenues, will insure that fisheries will play even greater roles in the state economy in the future. Already, economic studies on Alaska's commercial fishing industry for 1984 (Berman and Hull 1987) are somewhat out-dated due to significant growth in the industry's share of the state's economy over the past two years. Meaningful levels of funding for fishery management activities are now more important than ever so that these resources can be used wisely and in the best economic interests of the residents of Alaska during transition away from economic dependence on the petroleum industries. For example, Eggers (*In press*) has shown the relationships between increased expenditures on management, decreased management error, and increased returns to the Bristol Bay sockeye salmon fishery.

EVALUATION OF INVESTMENTS IN FISHERY ENHANCEMENT

The Division of Fisheries Rehabilitation, Enhancement and Development has utilized two economic tools for evaluation of the consequences of its investments in fishery enhancement. One is benefit-cost analysis and the other is economic impact analysis.

Benefit-cost analysis is a method for evaluating an investment or group of investments. With long-term investments the analysis is made by forecasting the benefits and costs that occur over a series of years. The present value of the net benefits (NPV) is estimated using discount rate. A project is considered efficient if the present value of the benefits minus the present value of the costs result in positive net benefits. The results of a study on state-owned hatcheries and private-nonprofit (PNP) hatcheries for 1984 demonstrated that the state's salmon enhancement investments would produce net benefits of approximately $90 million in the commercial fishery over the 25-year economic life of the projects (Hartman 1986). The variability in the estimates of the NPV was large, due to the distribution of probable harvests and uncertainties in price forcasting. A semi-log and linear market demand model was used to estimate price and the change in total revenue for the commercial fishery from a state accounting stance.

In the same study, the net benefits of enhancement-produced fish to the recreational fishery varied by over an order of magnitude. The pessimistic case had a NPV of approximately -$25 million, while the optimistic case had a NPV of +$316 million. Although it is very likely that benefits exceed costs for this part of the program (the midpoint of the analysis is $146 million), additional economic surveys are necessary to provide a more precise estimate of the consumer surplus of recreational fishing from enhancement.

The second economic methodology used for the evaluation of the salmon enhancement program has been an economic impact analysis, which was conducted independently by the Institute of Social and Economic Research (Scott Goldsmith, ISER, pers. comm., December 1986) of the University of Alaska at Anchorage. This analysis included a computer simulation model which estimates the regional wage and employment impacts from changes in the commercial salmon harvest. A simulation of the impacts of proposed FRED budgets for FY-88 revealed that the full funding request of $16.5 million results in the existence of over 850 resident jobs and $27 million in resident wages and income. Furthermore, a proposed reduction in the general fund request of $2.5 million for FRED results in the loss of over 135 of these jobs and $4.3 million in wages and income. It is apparent from this study that extracting even a small piece of the FRED program will significantly reduce commercial salmon harvest and impact the Alaskan economy through lost jobs, lowered personal income, and a reduced tax base.

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Table 1. United States commercial fisheries landings (millions of pounds, millions of dollars) for the Pacific Coast states.[a]

	Alaska		Washington		Oregon		California	
Year	Weight	Value	Weight	Value	Weight	Value	Weight	Value
1976	616.4	227.2	131.3	80.9	98.9	48.7	896.9	185.6
1977	644.0	326.2	146.1	80.8	112.5	48.5	874.4	195.0
1978	745.6	438.6	138.3	97.2	134.7	56.6	722.3	228.2
1979	898.5	597.0	170.0	116.0	127.8	65.2	728.4	227.5
1980	1053.9	560.6	155.8	85.5	126.3	55.7	804.3	323.4
1981	975.2	639.8	184.6	96.0	134.6	52.5	775.2	275.2
1982	878.9	575.6	170.2	90.1	127.6	57.5	695.4	241.2
1983	963.8	543.9	150.0	61.3	96.7	38.5	528.9	202.0
1984	1002.9	509.3	156.3	75.7	82.5	33.6	459.2	176.6
1985	1184.8	590.8	167.5	93.0	101.3	45.9	362.8	132.9
1986					112.8[b]	60.9[b]		

[a]Source: National Marine Fisheries Service. 1976-86. Fisheries of the United States, 1976-85. Current Fisheries Statistics 7200, 7500, 7800, 8000, 8100, 8200, 8300, 8320, and 8360.

[b]Source: Hans Radtke, P.O. Box 244, Yachats, OR 97498.

Table 2. Exvessel value (in millions of dollars) of Alaska's commercial fisheries.[a]

Species	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985[b]	1986[b]
Salmon	119.7	176.4	241.2	346.8	254.1	397.3	309.7	320.2	343.1	389.0	414.0
Shellfish	97.3	153.2	230.6	239.0	265.3	196.9	211.7	146.6	102.1	106.3	182.0
Halibut	20.5	17.6	23.4	32.9	13.5	19.3	24.9	35.3	24.9	40.3	79.4
Herring	2.5	2.7	7.2	32.7	12.2	18.6	20.2	28.9	19.8	38.0	38.5
Groundfish	1.1	1.6	3.3	6.3	8.9	24.0	40.9	78.0[c]	107.2[c]	137.5[c]	197.9[c]
Total	241.1	351.5	505.7	657.7	554.0	656.1	607.4	609.0	597.1	711.1	911.8

[a]Compiled February 12, 1988.
[b]The estimates for 1985 and 1986 are preliminary.
[c]The groundfish estimates for 1983-86 include JV and DAP landings both within and outside Alaska.

Table 3. Commercial groundfish landings (millions of pounds) by state, joint ventures[a], and totals for the Pacific coast of the United States over 1976-85.[b]

	Landings					
Year	Alaska	Washington	Oregon	California	Joint Ventures	U.S. Total
1976	1.0	47.8	25.0	64.1	0.0	137.8
1977	2.5	50.9	20.9	62.5	0.0	136.9
1978	5.8	58.9	31.8	64.0	0.0	160.6
1979	10.0	70.1	46.6	66.8	19.4	212.8
1980	18.1	81.8	77.5	76.5	306.9	560.8
1981	43.7	91.5	82.0	74.9	555.1	847.2
1982	60.9	95.3	90.2	113.5	556.9	916.8
1983	90.4	95.8	77.0	91.4	939.5	1,294.0
1984	98.5	100.0	62.3	89.4	1,438.0	1,788.1
1985	226.1	89.4	64.5	95.1	1,998.5	2,473.7

[a]Most joint venture landings come from Alaskan waters.

[b]Source: Pacific Marine Fisheries Commission Annual Reports, 1977-86. Foreign landings are not included in these data. In 1985 foreign landings totaled 2330 million lbs.; most of the foreign catch was taken from waters off Alaska.

Table 4. Commercial groundfish catch (millions of pounds) for 1985 in waters off Alaska by processor type.[a]

Type	Catch
Domestic Processor	270.1
Joint Venture	1,941.1
Foreign Processor	2,287.0
Total	4,498.2

[a]Source: Seafood Bussiness Report. 1986. Vol. 5. No. 2.

Table 5. Commercial groundfish catch (million pounds) for 1985 in waters off Alaska by species.[a]

Species	Catch
Pollock	3,279.3
Sablefish	33.2
Pacific Cod	340.4
Flatfish	709.1
Pacific Ocean Perch	5.3
Other Rockfish	2.5
Atka Mackerel	87.3
Other	41.1
Total	4,498.2

[a]Source: Seafood Bussiness Report. 1986. Vol. 5. No. 2.

Table 6. Commercial landings (thousands of fish) of salmon along the Pacific coast of the United States for 1973-85.[a]

Year	Alaska	Washington	Oregon	California
1973	22,319	7,446	1,159	1,165
1974	21,886	4,621	1,361	1,148
1975	26,229	4,999	882	783
1976	44,423	3,611	2,011	1,162
1977	46,405	6,009	786	598
1978	78,695	4,139	804	757
1979	86,559	7,079	1,149	823
1980	110,283	3,526	748	625
1981	111,425	7,687	854	627
1982	110,082	6,068	1,102	854
1983	127,159	4,236	435	331
1984	132,246	4,122	283	334
1985[b]	146,845	9,232	619	378

[a]Source: Seafood Business Report. 1985. Vol. 4. No. 2.

[b]Preliminary figures for 1985.

Table 7. Pacific coast shellfish[a] landings (millions of pounds) by state for 1976-85.[b]

Year	Landings by State			
	Alaska	Washington	Oregon	California
1976	317.2	19.1	34.6	20.9
1977	316.2	25.4	64.8	42.1
1978	334.0	21.5	69.2	27.1
1979	337.3	20.1	46.0	13.1
1980	364.7	19.2	48.5	17.9
1981	238.5	12.8	35.4	16.0
1982	143.1	7.6	27.3	14.8
1983	106.3	12.5	10.8	6.3
1984	86.1	8.3	9.5	6.9
1985	115.5	13.8	19.7	7.7

[a]Tanner crab, king crab, Dungeness crab and shrimp only.

[b]Source: Seafood Business Report, March/April 1986. Vol. 5 No. 2. King crab, Tanner crab and shrimp landings were tabulated by calendar year. Dungeness crab landings were tabulated by fishing season. Here, data for the 1975-76 fishing season for Dungeness crabs were summarized with data for the other species from 1976. The same association was done for the other years of data, as well.

Table 8. Total Alaska harvest (in numbers) of sport fish for 1977-85 from Mills (1986).

Species	1977	1978	1979	1980	1981	1982	1983	1984	1985
Chinook Salmon	43,060	44,149	51,749	46,248	58,997	74,536	83,112	85,010	90,718
Sea-Run Coho Salmon	104,991	131,945	119,329	164,302	125,666	195,550	149,270	238,536	200,997
Landlocked Coho/ Chinook Salmon	38,303	48,995	53,980	68,875	97,224	67,476	69,038	49,937	60,381
Sockeye Salmon	103,501	124,274	81,260	110,201	79,823	132,591	176,761	124,443	172,630
Kokanee Salmon	2,642	1,883	3,863	2,790	5,828	3,911	1,972	925	3,762
Pink Salmon	122,098	194,817	97,635	196,199	100,998	173,756	104,365	153,841	138,297
Chum Salmon	7,406	30,178	11,225	13,517	14,057	20,845	19,011	24,016	16,539
Steelhead	3,699	4,338	2,978	4,832	3,264	3,673	5,364	6,539	4,723
Rainbow Trout	94,310	120,231	139,473	153,647	178,613	173,283	168,782	182,336	193,027
Cutthroat Trout	25,289	24,145	20,836	25,372	17,322	23,470	20,429	19,536	21,394
Brook Trout	759	1,691	672	2,273	861	818	1,606	636	1,058
Lake Trout	17,469	12,010	15,477	18,041	18,316	20,550	20,304	16,925	18,663
Dolly Varden/ Arctic Char	119,047	141,544	199,942	182,981	191,689	167,485	221,872	192,387	184,157
Arctic Grayling	113,691	143,099	160,069	170,137	159,924	170,250	181,006	147,348	139,171
Northern Pike	11,982	12,520	12,741	17,000	16,536	18,964	21,476	18,641	17,943
Whitefish	6,748	11,713	9,666	11,464	9,251	15,433	16,872	16,719	30,337
Burbot	8,425	9,988	7,304	14,948	14,342	15,445	14,465	19,164	27,230
Sheefish	1,247	1,291	1,542	2,411	2,239	3,281	3,323	3,947	2,520
Smelt	390,691	223,442	278,203	333,577	294,497	212,529	360,856	408,323	334,775
Halibut	23,244	37,085	47,705	64,658	74,212	92,358	117,042	124,970	127,634
Rockfish	31,054	46,247	70,868	79,416	87,045	86,885	82,796	80,724	67,610
Razor Clams	961,695	981,111	1,058,969	869,067	916,471	1,075,637	1,186,751	1,197,475	1,206,660
Other Fish	68,981	52,776	56,727	75,356	60,881	79,980	59,807	38,417	64,331
Total	2,300,332	2,399,472	2,502,213	2,627,312	2,528,056	2,828,706	3,086,280	3,150,795	3,124,557

Table 9. Sport catch (thousands of fish) of salmon along the Pacific coast of the United States for 1976-84.[a]

Year	Alaska	Washington	Oregon	California
1976	201	1,750	669	139
1977	381	1,191	372	154
1978	525	1,108	387	128
1979	361	1,124	279	139
1980	531	853	417	107
1981	380	760	319	93
1982	596	737	214	174
1983	533	861	172	89
1984	626	547	140	108

[a]Source: Pacific Marine Fisheries Commission, Annual Reports.

Table 10. Subsistence Salmon catch and effort in Alaska for 1970-85.[a]

Year	Catch (1,000's of fish)	Effort[b] (No. Permits)
1970	941.0	5,438
1971	686.0	6,420
1972	543.0	6,680
1973	657.0	6,893
1974	950.0	6,527
1975	854.0	6,220
1976	783.0	6,600
1977	886.1	7,055
1978	830.6	8,852
1979	1,040.2	9,627
1980	1,232.8	10,219
1981	1,130.3	10,099
1982	1,273.7	13,684
1983	1,233.9	12,101
1984	1,184.5	13,194
1985	1,157.7	14,472

[a]Source: Mike Dean, Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau.

[b]Effort is measured in number of returned permits in all districts except Kotzebue, Port Clarence, Norton Sound, Yukon, Kuskokwim and the Aleutian Islands where effort is reported in number of family units fishing.

Table 11. Number of vessels licensed to fish commercially in Alaska (excluding the AYK Region) for 1978-86.[a]

Year	Alaskan Residents	Non-Residents	Individuals of Unknown Residency	Total Vessel Licenses
1978	11,193	2,012	1,305	14,510
1979	11,880	2,402	1,407	15,689
1980	12,741	2,646	1,541	16,928
1981	12,399	2,405	1,513	16,317
1982	12,594	2,422	1,624	16,640
1983	13,367	2,451	1,718	17,536
1984	11,794	2,589	1,998	16,381
1985	11,116	2,552	2,068	15,736
1986	11,062	2,674	2,103	15,839

[a]Source: Kurt Schelle, ADF&G, Commercial Fisheries Entry Commission, Juneau.

Table 12. Number of permits purchased for commercial fishing in Alaska for 1974-86.[a]

Year	Permits Purchased by		Total Permits Purchased
	Alaskan Residents	Non-Residents	
1974	15,965	2,807	18,772
1975	15,765	3,327	19,092
1976	16,101	3,149	19,250
1977	17,421	3,393	20,814
1978	20,306	3,784	24,090
1979	23,723	5,147	28,870
1980	26,388	6,050	32,438
1981	24,615	5,081	29,696
1982	25,042	5,192	30,234
1983	26,124	4,886	31,010
1984	25,653	4,631	30,284
1985	24,527	4,479	29,006
1986	24,059	4,604	28,663

[a]Source: Kurt Schelle, ADF&G, Commercial Fisheries Entry Commission, Juneau.

Table 13. Number of individuals purchasing Alaska fishing permits for 1974-86. Individuals may purchase more than one permit.[a]

Year	Alaskan Residents	Non-Residents	Total Individuals
1974	9,929	2,014	11,943
1975	10,633	2,543	13,176
1976	10,975	2,467	13,442
1977	11,640	2,536	14,176
1978	13,152	2,841	15,993
1979	14,244	3,460	17,704
1980	15,375	4,223	19,598
1981	14,471	3,543	18,014
1982	14,650	3,596	18,246
1983	15,415	3,432	18,847
1984	15,285	3,344	18,629
1985	14,746	3,304	18,050
1986	14,024	3,316	17,340

[a]Source: Kurt Schelle, ADF&G, Commercial Fisheries Entry Commission, Juneau.

Table 14. Number of crew member licenses purchased by Alaska residents and non-residents over 1976-86.[a]

Year	Residents	Non-Residents	Total
1976	17,747	7,136	24,883
1977	20,603	7,965	28,568
1978	14,332	7,509	21,841
1979	16,525	8,685	25,210
1980	15,400	8,828	24,228
1981	16,494	9,714	26,208
1982	18,309	10,887	29,196
1983	17,363	9,410	26,773
1984	16,929	9,258	26,187
1985	17,398	9,337	26,735
1986	19,887	10,017	29,904

[a]Source: Alaska Department of Revenue, Juneau.

Table 15. Estimates of participation in Alaska fisheries by Alaska residents over 1977-84 from Focht (1986).

Year	Total Participants	Resident Alaskan Participants	Percentage of Alaskans
1977	26,077	20,488	78.6
1978	29,716	23,036	77.5
1979	32,950	25,168	76.4
1980	32,853	24,403	74.3
1981	32,732	24,641	75.3
1982	32,915	24,370	75.1
1983	34,664	26,543	76.6
1984	29,604	22,123	74.7

Table 16. Number of companies, number of plants, and peak number of employees involved in fish processing in Alaska for 1976-85.[a]

Year	Processor Type	Number of Plants	Number of Companies	Peak No. of Employees
1976	Total	184	154	11,246
1977	Total	199	172	11,498
1978	Land-based	129	b	12,744
	Floating	49	b	1,398
	Total	184	b	14,142
1979	Land-based	131	b	13,693
	Floating	60	b	2,187
	Total	191	b	15,880
1980	Land-based	130	b	14,618
	Floating	65	b	2,466
	Total	195	b	17,084
1981	Land-based	181	138	15,025
	Floating	88	69	2,504
	Total	269	207	17,529
1982	Land-based	281	182	15,363
	Floating	285	140	8,384
	Total	566	322	23,747
1983	Land-based	274	173	16,341
	Floating	350	205	9,398
	Total	624	378	25,739
1984	Land-based	285	212	17,057
	Floating	486	334	7,338
	Total	771	546	24,395
1985	Land-based	276	198	23,542
	Floating	353	244	7,682
	Total	629	442	31,224

[a]Source: ADF&G Catch and Production Leaflets, 1976-84. Data for 1985 and 1986 from ADF&G, Computer Services Section files. Catcher/Sellers included in 1976-80. In 1986, 518 plants filed an intent to operate.

[b]Data not available.

Table 17. Number of sport fishing licenses purchased by Alaska residents and non-residents for 1975-85.[a]

Year	Alaskan Residents	Non-residents	Total
1975	101,900	45,821	147,721
1976	117,681	48,613	166,294
1977	121,913	55,821	177,734
1978	129,750	65,481	195,231
1979	130,458	72,090	202,548
1980	132,103	74,699	206,802
1981	138,784	87,407	226,191
1982	156,324	105,014	261,338
1983	169,761	102,481	272,242
1984	177,949	115,127	293,076
1985	176,725	127,077	303,802

[a]Source: Brad Odelle, Department of Revenue, Juneau, Alaska. Licenses include all types of licenses which allow an individual to sport fish. These figures do not represent the actual number of individuals who sport-fished in Alaska during these years. Some individuals have purchased more than one license. For example, an individual might purchase two 14-day licenses in one calendar year. Also some individuals (youths under the age of 16) are not required to purchase licenses for sport fishing and are not counted at all.

Table 18. Fisheries revenues (thousands of dollars) collected by the state of Alaska for fiscal years 1977-86.[a]

Fiscal Year	Revenues that go to the Gen. Fund: Salmon Enh. Tax (1)	Other Taxes	Licenses & Permits	Federal Sources (2)	Fish & Game Fund (3)	Grand Total	Grand Total minus (1),(2)&(3)
1977	0	7,561.3	498.5	824.5	5,292.4	14,176.7	8,059.8
1978	0	10,369.1	2,580.3	871.2	6,468.8	20,289.4	12,949.4
1979	0	14,546.5	3,722.7	715.6	6,927.6	25,912.5	18,269.3
1980	0	17,887.3	3,614.5	420.6	6,428.3	28,350.6	21,501.7
1981	0	24,276.2	3,512.2	635.1	9,051.0	37,474.5	27,788.4
1982	2,425.0	26,518.2	3,448.6	6,475.1	3,039.6	41,906.5	29,966.8
1983	2,553.8	25,736.8	4,083.8	6,491.1	3,969.3	42,834.8	29,820.6
1984	2,241.3	24,023.8	4,050.4	7,088.5	4,079.5	41,483.5	28,074.2
1985	2,625.3	23,924.9	4,846.7	5,238.9	4,235.9	40,871.7	28,771.6
1986	4,263.1	27,516.0	5,073.0	6,558.3	3,890.6	47,301.0	32,589.0

[a]Source: Bob Elliott, Alaska Department of Revenue, Juneau. Hunting and trapping license fees have been excluded from these figures.

Table 19. Alaska fishery expenditures (thousands of dollars) in fiscal year 1987 (revised) for each department of state government and for the Sea Grant and Marine Advisory programs of the University of Alaska.

Division/Program	General Funds	Federal Funds	Other Funds	Total
Department of Fish and Game				
Commercial Fisheries Division	14,839.2	3,995.3	877.9	19,712.4
Fish & Game Vessels	1,245.1	0.0	0.0	1,245.1
Sport Fisheries Division	0.0	4,610.9	3,539.9	8,150.8
FRED Division	11,849.3	2,983.2	370.0	15,202.5
Entry Commission	2,012.4	103.3	67.5	2,183.2
Habitat Division[a]	1,363.1	38.6	348.2	1,749.8
Board of Fisheries[a]	249.4	298.3	0.0	547.7
Subsistence Division[a]	959.4	350.0	0.0	1,309.4
Administration Division[b]	1,729.2	10.0	174.7	1,913.9
Department Total	34,247.1	12,389.6	5,378.2	52,014.8
Department of Commerce and Economic Development				
Office of International Trade[c]	71.9	0.0	0.0	71.9
Office of Fisheries Development	344.5	0.0	19.0	363.5
AK Seafood Marketing Institute	1,639.7	254.5	1,000.0	2,894.2
Department Total	2,056.1	254.5	1,019.0	3,329.6
Department of Public Safety				
Fish & Wildlife Protection[d]	7,534.5	0.0	0.0	7,534.5
Department Total	7,534.5	0.0	0.0	7,534.5
Department of Environmental Conservation				
Seafood Inspection Program	865.1	98.0	0.0	963.1
Department Total	865.1	98.0	0.0	963.1
Department of Community and Regional Affairs				
Fisheries-Related Grants	482.0	0.0	0.0	482.0
Department Total	482.0	0.0	0.0	482.0
Total - All Departments	45,184.8	12,742.1	6,397.2	64,324.0

-continued-

Table 19. (page 2 of 2)

Division/Program	General Funds	Federal Funds	Other Funds	Total
University of Alaska				
Sea Grant and Marine Advisory Programs	1,109.5	1,529.5	25.0	2,664.0
University Total	1,109.5	1,529.5	25.0	2,664.0
EXPENDITURE GRAND TOTAL	46,294.3	14,271.6	6,422.2	66,988.0

[a]Expenditures of these programs on fisheries are estimated to be 50% of the total of these programs.

[b]Expenditures of this program on fisheries are estimated to be 40% of the total of this program.

[c]Expenditures of this program on fisheries are estimated to be 10% of the total of this program.

[d]Expenditures of this program on fisheries are estimated to be 65% of the total of this program.

Table 20. Sources of data shown in Table 19.

Division/Program	Source(s)	Phone Number(s)
Dept. of Fish and Game	Beverly Reaume Al Didier	465-4120 465-4210
Dept. of Environmental Conservation	Doug Donegan Don Bennett	465-2696 465-2609
Office of Fisheries Development	Paul Peyton	465-2162
Alaska Seafood Marketing Institute	Pete Carlson	586-2902
Office of International Trade	Don Hajenga	562-2989
Dept. of Public Safety	Kyle Weaver Joe Reeves	269-5539 465-4350
Univ. of Alaska Statewide Finance	Paullette Wille	474-7593
Univ. of Alaska Sea Grant	Ron Dearborn	474-7086
Univ. of Alaska Marine Advisory	James Matthews	474-7246
Univ. of Alaska C&RA Grants	Pauline Valha	561-8586

Table 21. Estimated general fund expenditures (in millions of dollars) associated with management of Alaska's commercial fisheries resources for each division of ADF&G for FY-87.[a]

Division	Total General Fund Expenditure	Approximate % Applied to Fish. Management	Estimated Fisheries Management Cost
Commercial Fisheries	14.8	100	14.8
Sport Fish	0.0	100	0
FRED	11.8	100	11.8
Administration	4.3	40	1.7
Boards	.5	50	.3
Habitat	2.7	50	1.4
Subsistence	1.9	50	1.0
CFEC	2.0	100	2.0
Vessels	1.2	100	1.2
Total			34.2

[a]Source: ADF&G budget files.

Table 22. Estimated general fund expenditures on fisheries management activities by ADF&G. The following percentages were applied to the total general fund expenditure of each division to achieve the expenditures associated with fisheries management: 100% applied to Commercial Fisheries, Sport Fish, FRED, CFEC and Vessels; 50% applied to Boards, Habitat, and Subsistence; and 40% applied to Administration.[a]

Fiscal Year	Estimated General Fund Expenditure Toward Fisheries Management (millions of dollars)
1976	11.78346
1977	14.04710
1978	15.86515
1979	20.97822
1980	23.98779
1981	29.83612
1982	36.41587
1983	37.97806
1984	38.09370
1985	42.95517
1986 Authorized	42.42170
1987 Restricted	34.24710

[a]Source: ADF&G budget files.

Table 23. Estimated general fund expenditures, adjusted using the Anchorage Consumer Price Index relative to 1976[a], which were devoted to fisheries management activities by the Alaska Department of Fish and Game. These are the same data of Table 22, adjusted for inflation.[b]

Fiscal Year	Estimated General Fund Expenditure Toward Fisheries Management (millions of dollars)
1976	11.78346
1977	13.17217
1978	13.88518
1979	16.63056
1980	17.24976
1981	19.86250
1982	22.96635
1983	23.54439
1984	22.68206
1985	24.96969
1986 Authorized	24.08789
1987 Restricted	18.99772

[a]Source: Anchorage Consumer Price Index from John Boucher, Alaska Department of Labor, Division of Research and Analysis, Juneau.

[b]Source: General fund expenditures from ADF&G budget files.

Table 24. Actual expenditures (in dollars) by ADF&G, Division of Commercial Fisheries (excluding Vessels Section) for 1976-87.[a]

Fiscal Year	General Fund	Federal Sources	Test Fishing	Other Sources	Grand Total
1976	5,423,700	1,311,600	29,200	32,300	6,796,800
1977	6,644,500	1,597,200	30,800		8,272,500
1978	7,664,200	2,375,700	53,400		10,093,300
1979	8,691,200	1,653,900	60,800	12,100	10,418,000
1980	10,168,100	1,857,700	25,000	91,400	12,142,200
1981	12,485,100	1,317,700	100,000	840,200	14,743,000
1982	15,214,200	1,118,700	148,500	1,460,100	17,941,500
1983	16,419,400	1,893,100	91,100	754,600	19,158,200
1984	16,880,800	1,649,300	63,800	888,200	19,482,100
1985	18,412,000	1,877,100	158,200	964,200	21,411,500
1986	18,258,600	2,279,400	255,300	1,854,600	22,647,900
1987[b]	14,839,200	3,995,300	318,000	559,900	19,712,400

[a]Source: ADF&G budget files.

[b]Restricted budget.

Table 25. Actual expenditures (in dollars) by ADF&G, Division of Commercial Fisheries (including Vessels Section) for 1976-87.[a]

Fiscal Year	General Fund	Federal Sources	Test Fishing	Other Sources	Grand Total
1976	6,211,400	1,311,600	29,200	32,300	7,584,500
1977	7,717,100	1,597,200	30,800		9,345,100
1978	8,856,100	2,375,700	53,400		11,285,200
1979	10,037,700	1,653,900	60,800	12,100	11,764,500
1980	11,709,700	1,857,700	25,000	91,400	13,683,800
1981	14,306,200	1,317,700	100,000	840,200	16,564,100
1982	17,132,200	1,118,700	148,500	1,460,100	19,859,500
1983	18,365,000	1,893,100	91,100	754,600	21,103,800
1984	18,516,700	1,649,300	63,800	888,200	21,118,000
1985	20,197,700	1,877,100	158,200	964,200	23,197,200
1986	19,893,900	2,279,400	255,300	1,854,600	24,283,200
1987[b]	16,084,300	3,995,300	318,000	559,900	20,957,500

[a]Source: ADF&G budget files.

[b]Restricted budget.

Table 26. Inflation-adjusted (using Anchorage CPI relative to 1976)[a] expenditures of general funds (in dollars) by ADF&G, Division of Commercial Fisheries, Vessels Section, Division of Fisheries Rehabilitation, Enhancement and Development, and Division of Sport Fisheries for 1976-87.[b]

Fiscal Year	Div. of Comm. Fish.	Vessels Section	Div. of FRED	Div. of Sport Fish.
1976	5,423,700	787,700	4,543,200	0
1977	6,230,643	1,005,792	4,323,894	506,272
1978	6,707,708	1,043,151	4,960,984	0
1979	6,889,980	1,067,443	7,327,501	3,567
1980	7,311,942	1,108,574	6,041,282	174,887
1981	8,311,582	1,212,343	7,027,474	80,685
1982	9,595,120	1,209,623	7,972,346	270,242
1983	10,179,160	1,206,169	7,696,209	583,618
1984	10,051,304	974,061	7,625,827	353,922
1985	10,702,831	1,038,021	8,549,069	609,606
1986	10,361,867	928,043	8,098,085	356,110
1987[c]	8,221,553	689,839	6,565,020	0

[a]Source: Anchorage Consumer Price Index from John Boucher, Alaska Department of Labor, Division of Research and Analysis, Juneau.

[b]Source: ADF&G budget files.

[c]Restricted budget.

Table 27. Actual expenditures (in dollars) by ADF&G, Division of Fisheries Rehabilitation, Enhancement and Development for 1976-87.[a]

Fiscal Year	General Fund	Federal Sources	Fish & Game Fund	Other	Grand Total
1976	4,543,200	10,500	0	0	4,553,700
1977	4,611,100	84,400	0	0	4,695,500
1978	5,668,400	9,900	0	63,800	5,742,100
1979	9,243,100	0	0	0	9,243,100
1980	8,401,100	0	0	0	8,401,100
1981	10,556,200	30,300	0	88,100	10,674,600
1982	12,641,100	17,000	0	133,600	12,791,700
1983	12,414,300	101,300	0	128,200	12,643,800
1984	12,807,300	86,200	0	91,300	12,984,800
1985	14,706,900	248,100	0	46,600	15,001,600
1986	14,269,600	1,070,700	500,000	139,000	16,004,300
1987[b]	11,849,300	2,983,200	250,000	40,000	15,202,500

[a]Source: ADF&G budget files.

[b]Restricted budget.

Table 28. Actual expenditures (in dollars) by ADF&G, Division of Sport Fisheries for 1976-87.[a]

Fiscal Year	General Fund	Federal Sources	Fish & Game Fund	Other	Grand Total
1976	0	1,221,100	1,121,700	0	2,342,800
1977	539,900	1,290,400	941,800	16,500	2,788,600
1978	0	1,482,300	1,842,100	0	3,324,400
1979	4,500	1,388,700	2,394,400	32,700	3,820,300
1980	243,200	1,685,500	1,865,100	32,400	3,826,200
1981	121,200	1,990,500	2,284,600	432,000	4,828,300
1982	428,500	1,915,700	2,725,200	1,245,000	6,314,400
1983	941,400	1,344,100	2,850,800	2,386,200	7,522,500
1984	594,400	1,869,500	2,945,000	2,611,900	8,020,800
1985	1,048,700	1,797,000	3,730,400	3,045,800	9,621,900
1986	627,500	5,228,900	3,475,000	3,522,200	12,853,600
1987[b]	0	4,610,900	3,491,800	48,100	8,150,800

[a]Source: ADF&G budget files.

[b]Restricted budget.

Table 29. Total expenditures (in millions of dollars) by ADF&G[a], Washington Department of Fisheries[b], Washington Department of Game[c], Oregon Department of Fish and Wildlife[d], and California Department of Fish and Game[e] for recent years.

	ADFG			WDF		WDG		WDF + WDG	ODFW		
Funding Source	FY 86 (Annual)	FY 87 (Annual)	FY 86-87 Average (Annual)	1985-1987 Appropriated (Biennium)	1/2 1985-1987 Appropriated (Annual)	1985-1987 Appropriated (Biennium)	1/2 1985-1987 Appropriated (Annual)	1985-1987 Total (Annual)	1985-1987 Appropriated (Biennium)	1/2 1985-1987 Appropriated (Annual)	CDFG FY-86 (Annual)
General Fund	51.8	41.4	46.5	44.6	22.3	0.1	0.0	22.3	12.6	6.3	32.7
Federal Fund	14.5	17.4	16.0	14.0	7.0	12.2	6.1	13.1	42.5	21.3	19.5
Other Funds	15.5	10.8[f]	13.2	4.2	2.1	44.6[g]	22.3	24.4	45.0[h]	22.5	54.4[i]
Total	81.7	69.5	75.6	62.8	31.4	56.9	28.4	59.8	100.0	50.0	106.6

[a]Source: ADFG budget files.
[b]Source: Ray Ryan, Washington Department of Fisheries.
[c]Source: Washington Department of Game, 1987-1989 Budget Request Summary. 14 p.
[d]Source: Robert E. Mullen, Oregon Department of Fish and Wildlife, Corvallis, OR.
[e]Source: Tom Jow, California Department of Fish and Game.
[f]Includes $7.9 million from Fish and Game Fund.
[g]Includes $41.8 million from state Game Fund revenues, and $1.6 million from local Game Fund revenues.
[h]Almost entirely revenues from license sales, private utilities, private fish hatcheries, etc.
[i]Entirely revenues from licenses, taxes, etc.

Table 30. Estimated[a] total expenditures (in millions of dollars) on management of fisheries resources by the ADF&G)[b], Washington Department of Fisheries[c], Washington Department of Game[d], Oregon Department of Fish and Wildlife[e], and California Department of Fish and Game[f] for recent years.

Funding Source	ADFG			WDF		WDG		WDF + WDG 1985-1987 Total (Annual)	ODFW		CDFG FY-86 (Annual)
	FY 86 (Annual)	FY 87 (Annual)	FY 86-87 Average (Annual)	1985-1987 Appropriated (Biennium)	1/2 1985-1987 Appropriated (Annual)	1985-1987 Appropriated (Biennium)	1/2 1985-1987 Appropriated (Annual)		1985-1987 Appropriated (Biennium)	1/2 1985-1987 Appropriated (Annual)	
General Fund	42.4	34.3	38.4	44.6	22.3	0.1	0.0	22.4	12.1	6.0	21.0
Federal Fund	9.3	11.3	10.3	14.0	7.0	7.0	3.5	10.5	31.1	15.6	12.5
Other Funds	5.7	5.3[g]	5.5	4.2	2.1	25.4[h]	12.7	14.8	33.3[i]	16.7	35.0[j]
Total	57.4	50.9	54.2	62.8	31.4	32.5	16.2	47.7	76.5	38.3	68.5

[a]Estimated by Gordon Kruse, ADFG, Division of Commercial Fisheries, Juneau, using figures provided by other state agencies.
[b]Source: ADFG budget files.
[c]Source: Ray Ryan, Washington Department of Fisheries.
[d]Source: Washington Department of Game, 1987-1989 Budget Request Summary. 14 p.
[e]Source: Robert E. Mullen, Oregon Department of Fish and Wildlife, Corvallis, OR.
[f]Source: Tom Jow, California Department of Fish and Game.
[g]Includes $3.5 million from Fish and Game Fund.
[h]Includes approximately $22.9 million from state Game Fund revenues, and $0.9 million from local Game Fund revenues.
[i]Almost entirely revenues from license sales, private utilities, private fish hatcheries, etc.
[j]Entirely revenues from licenses, taxes, etc.

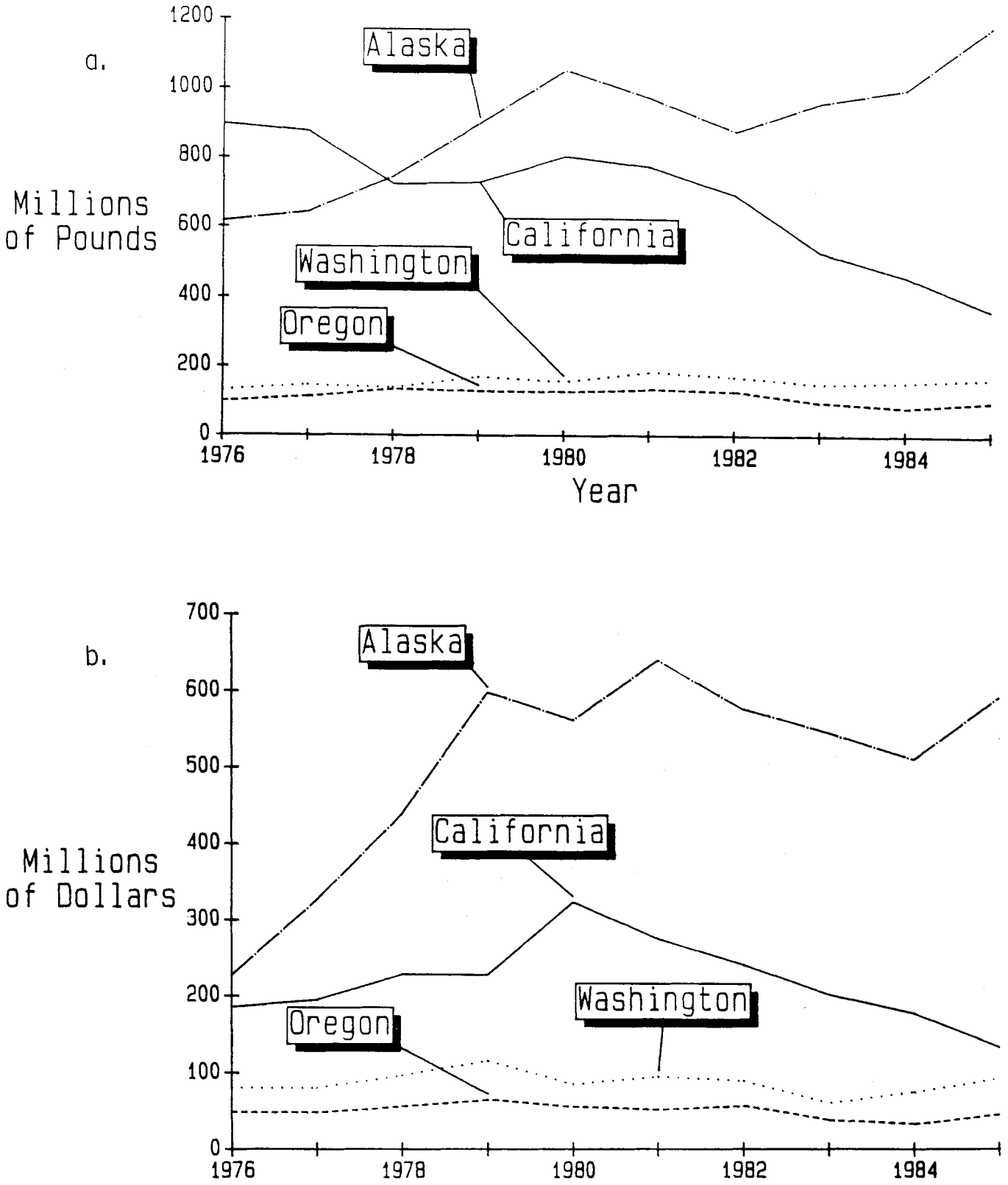

Figure 1. United States commercial fisheries landings in (a) weight and (b) value for the Pacific Coast states from 1976-85.

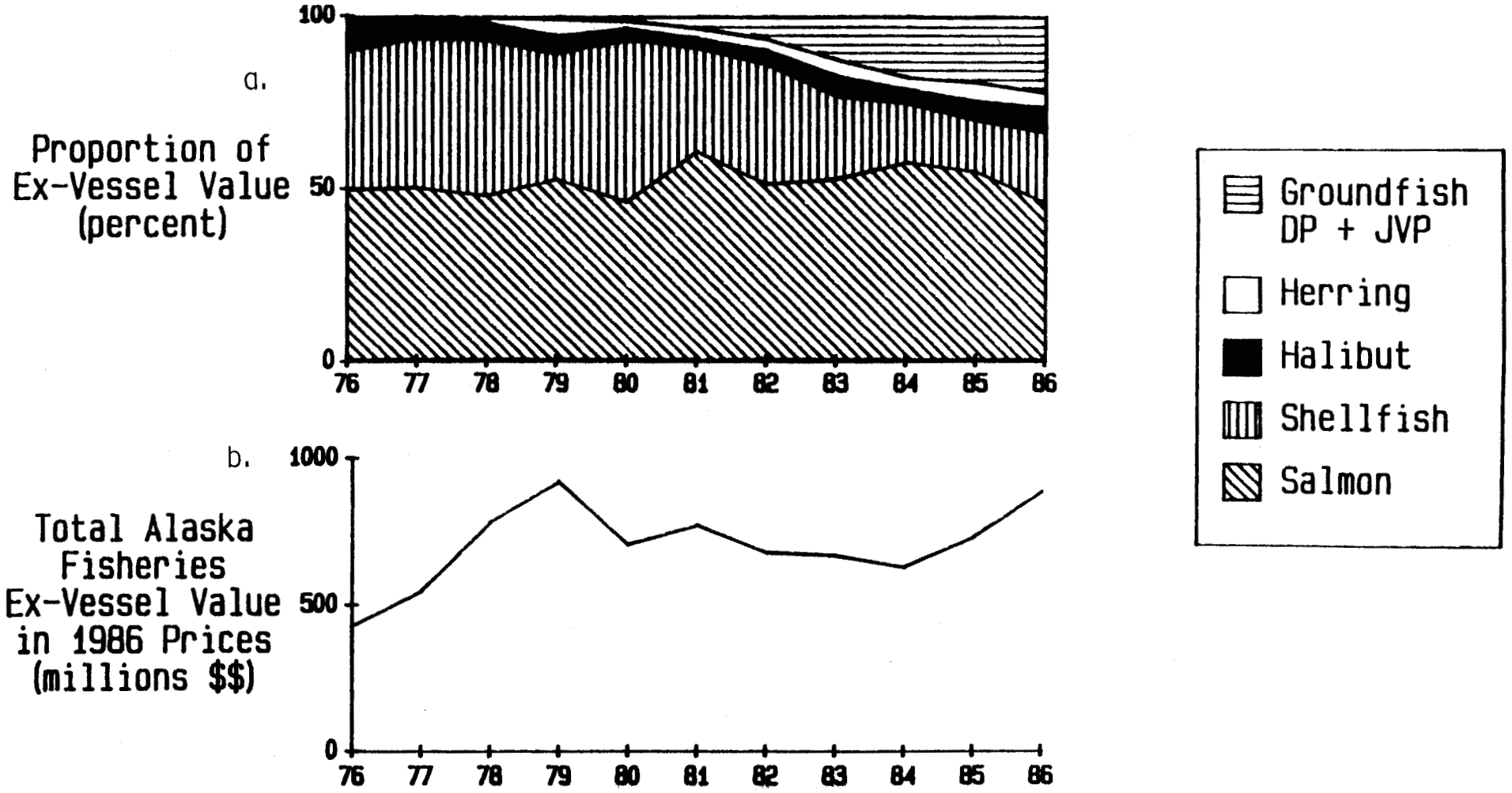

Figure 2. The (a) proportion of ex-vessel value by species group, and (b) total ex-vessel value (inflation adjusted to 1986 prices) of fisheries landings into Alaskan ports for 1976-86.

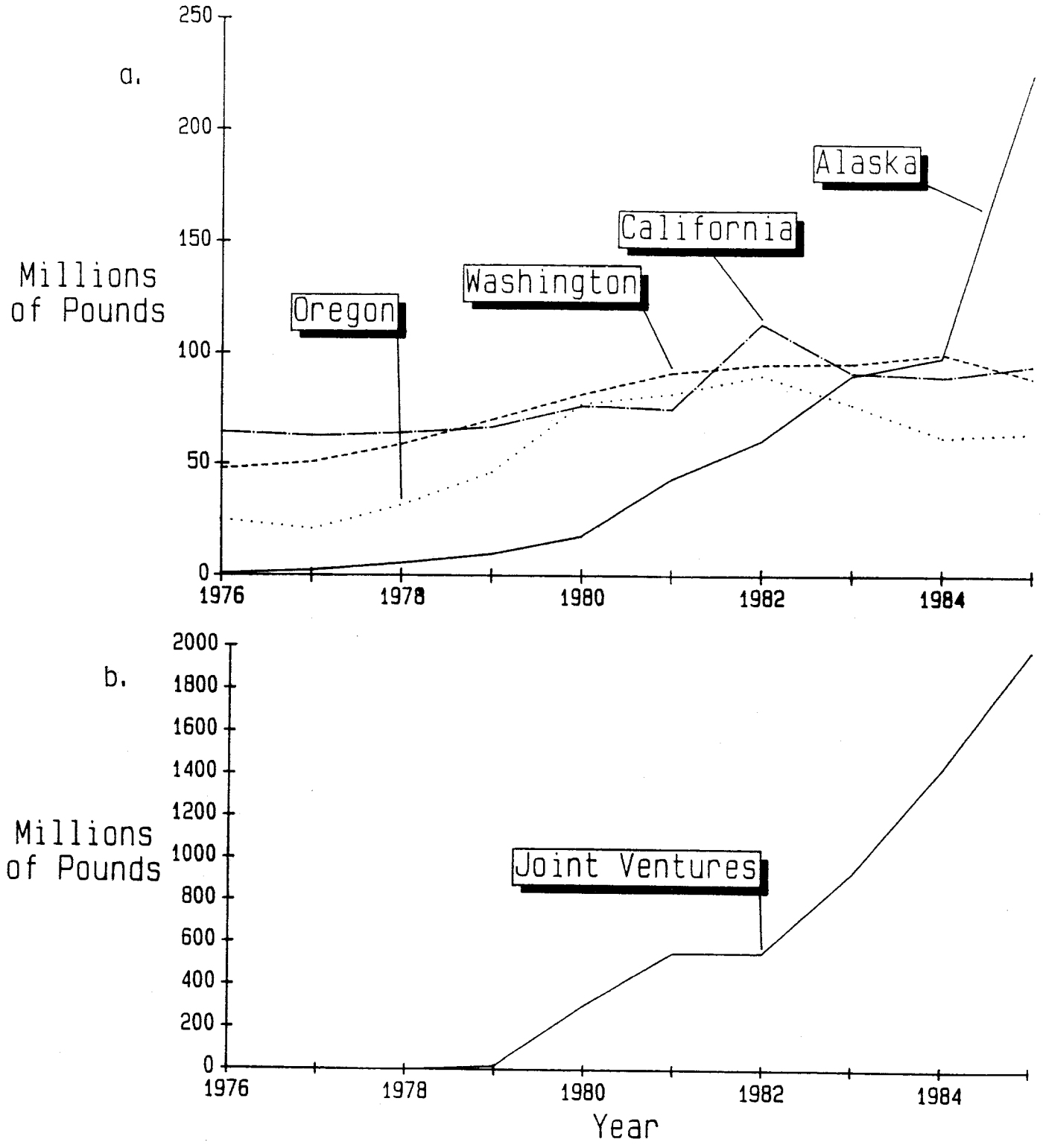

Figure 3. Pacific coast groundfish landings for (a) each state, and (b) joint-venture fisheries for 1976-85.

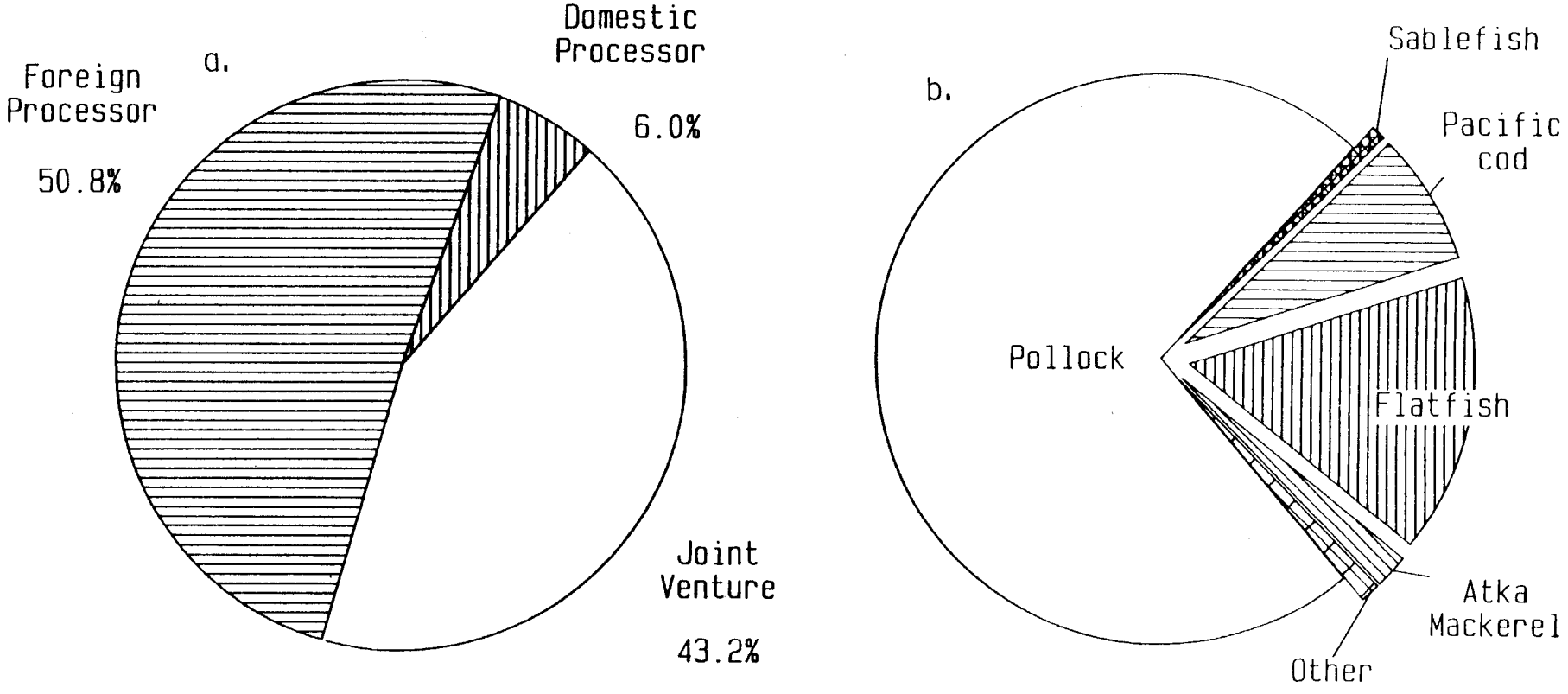

Figure 4. Commercial groundfish catch in Alaskan waters in 1985 by (a) processor type, and (b) species.

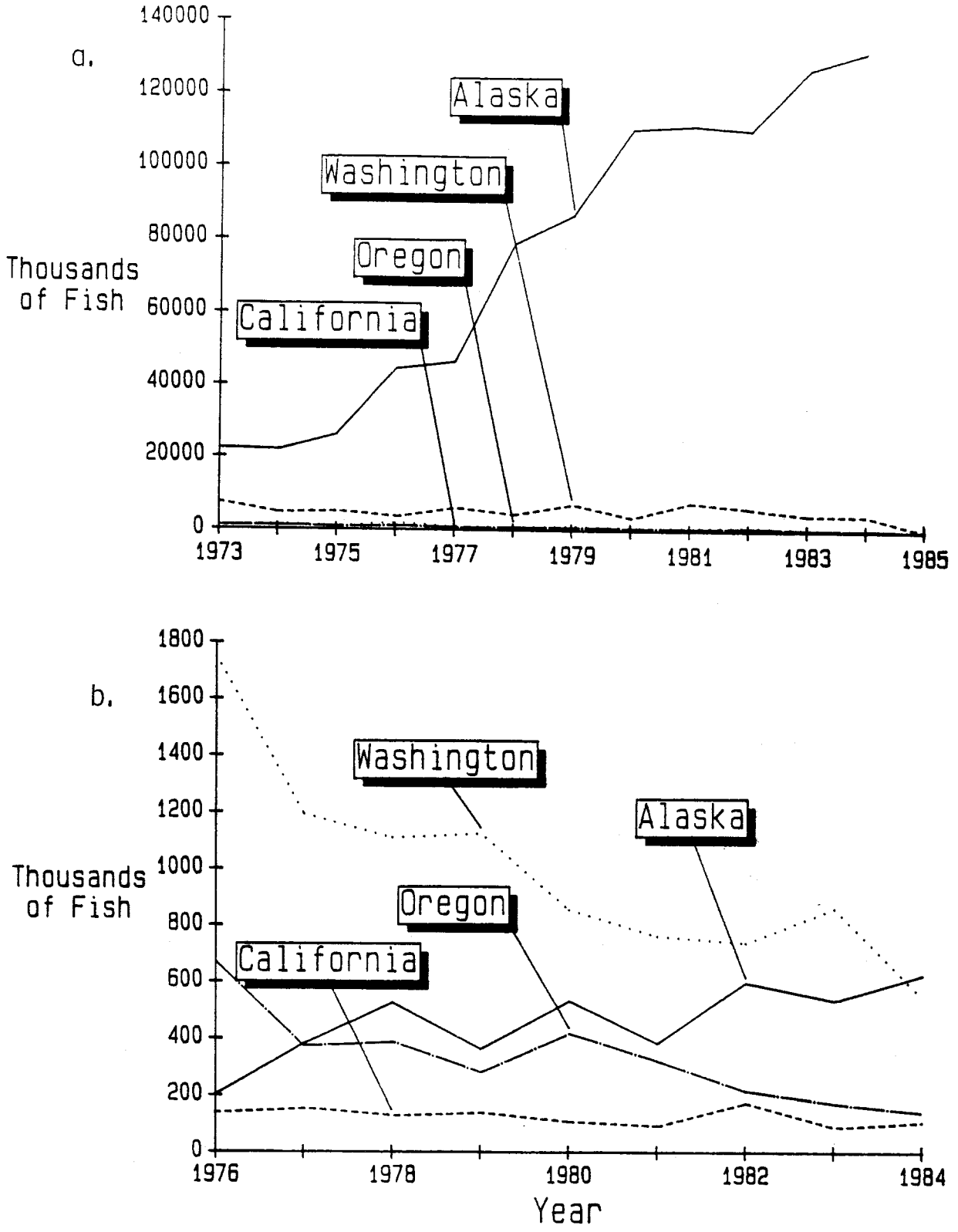

Figure 5. Pacific coast landings of salmon by (a) commercial fishermen for 1973-85, and (b) sport fishermen for 1976-1984.

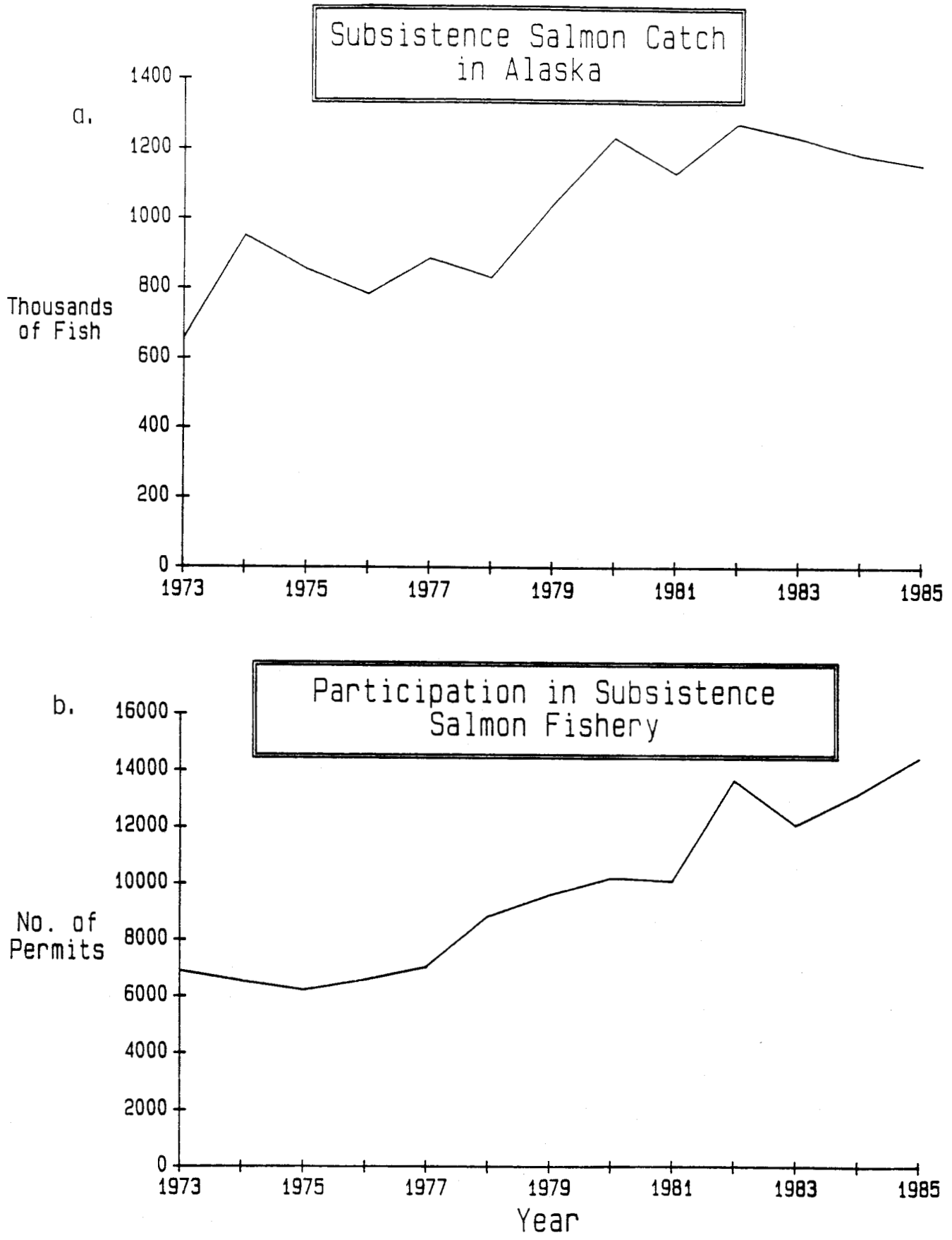

Figure 6. Subsistence salmon (a) catch, and (b) participation in 1973-85. See footnote b of Table 10.

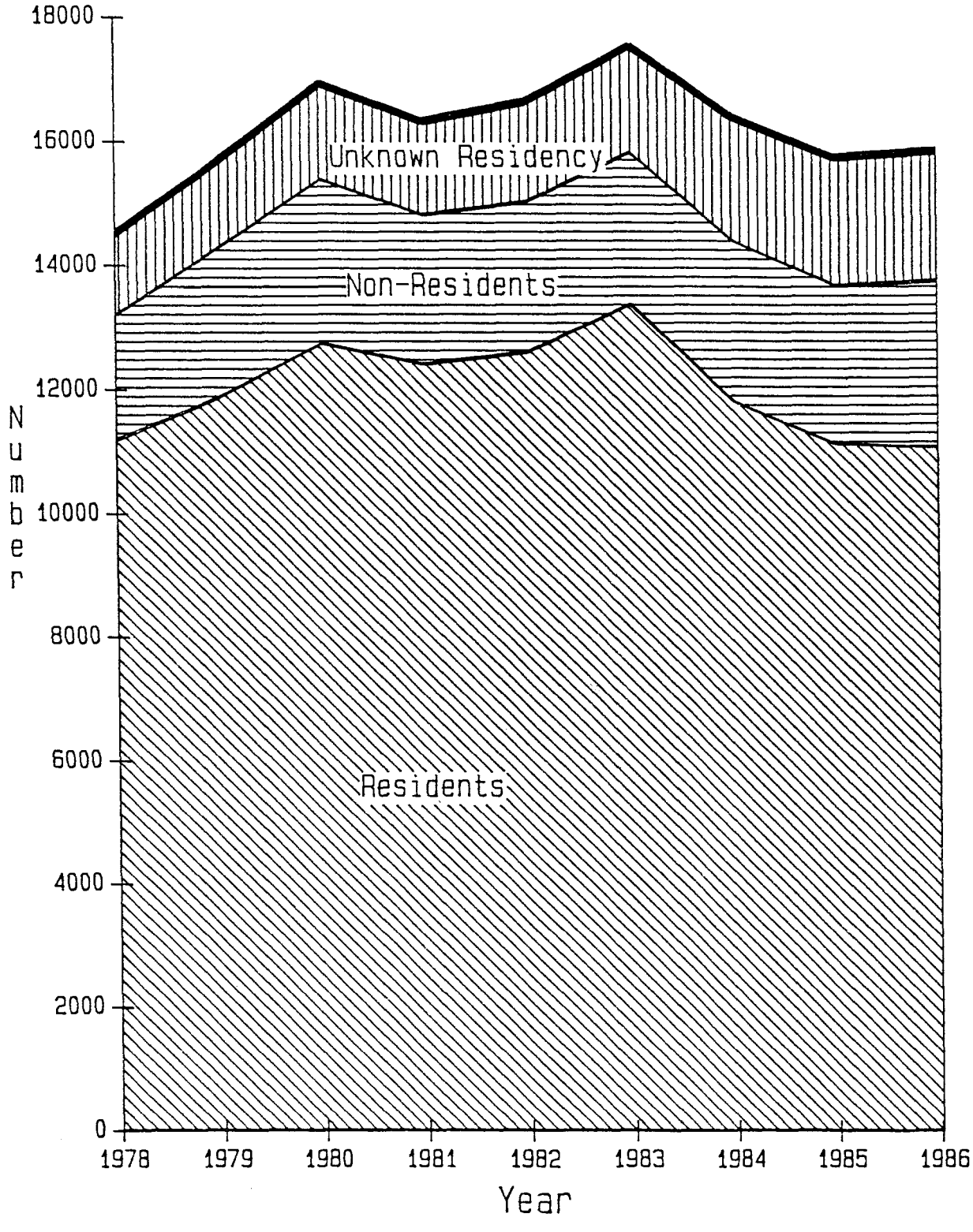

Figure 7. Number of vessels licensed to fish commercially in Alaska by Alaska residents and non-residents in 1978-86.

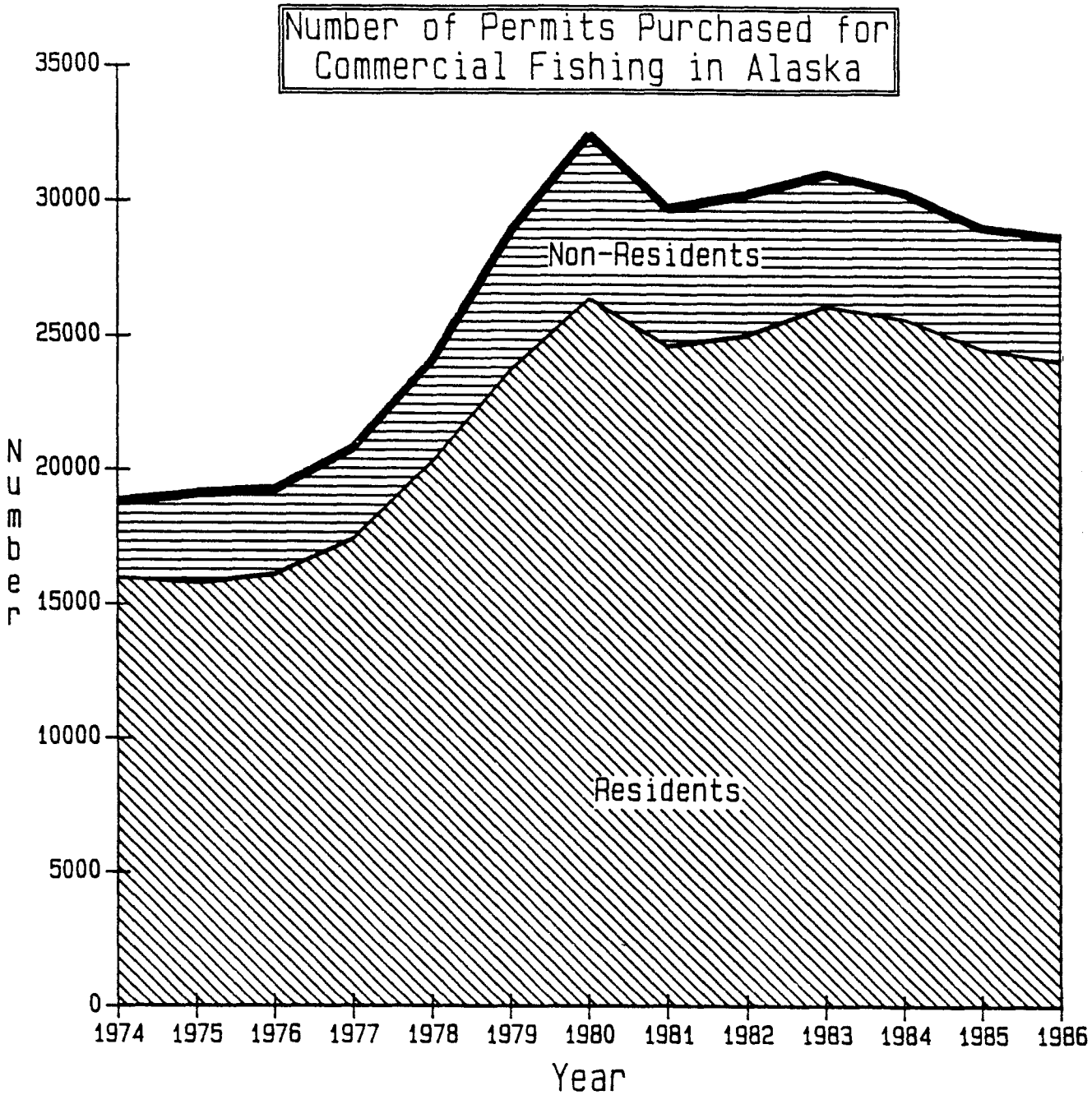

Figure 8. Number of permits purchased for commercial fishing in Alaska by Alaska residents and non-residents in 1974-86.

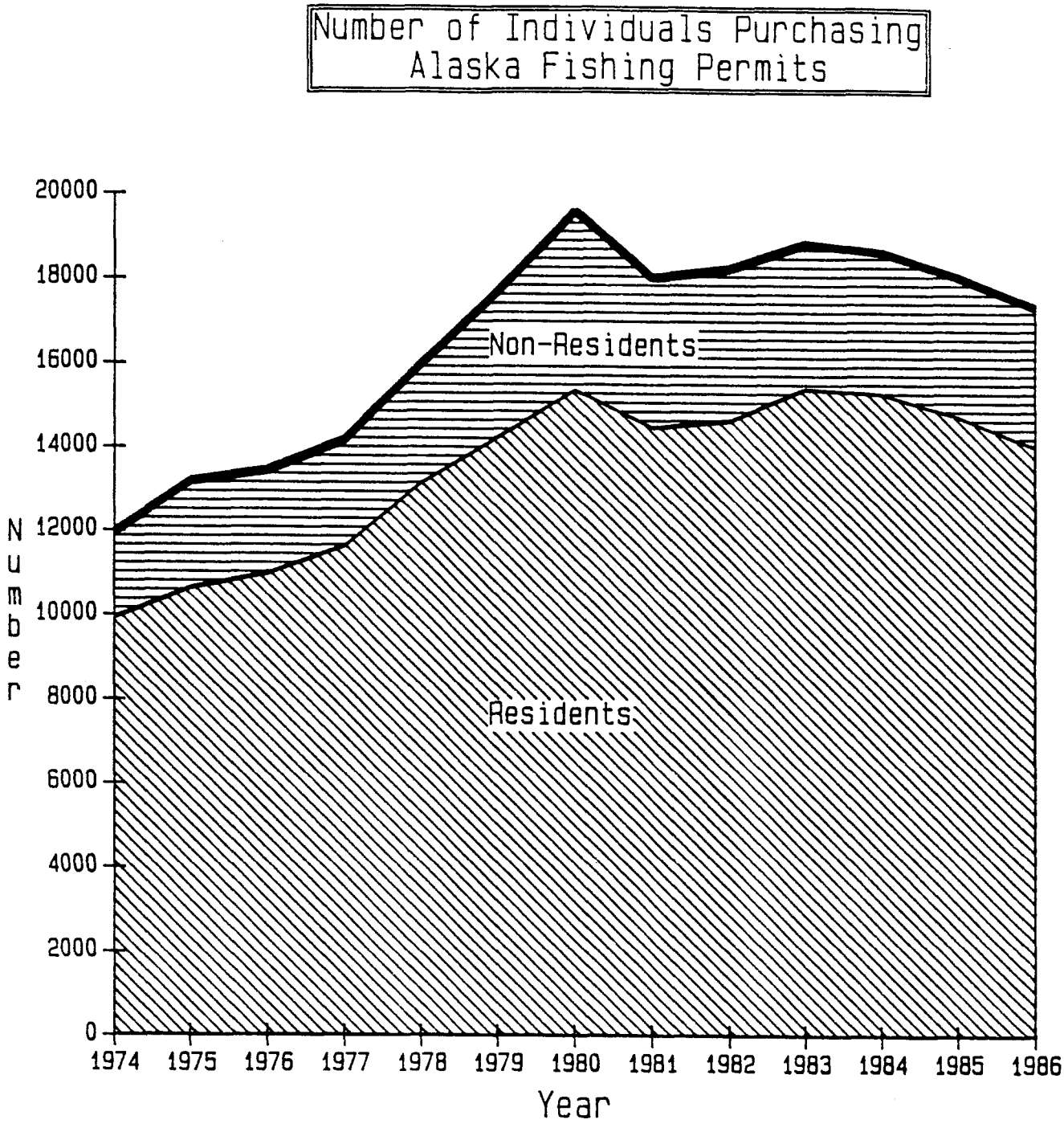

Figure 9. Number of Alaska residents and non-residents purchasing commercial fishing permits in 1974-86.

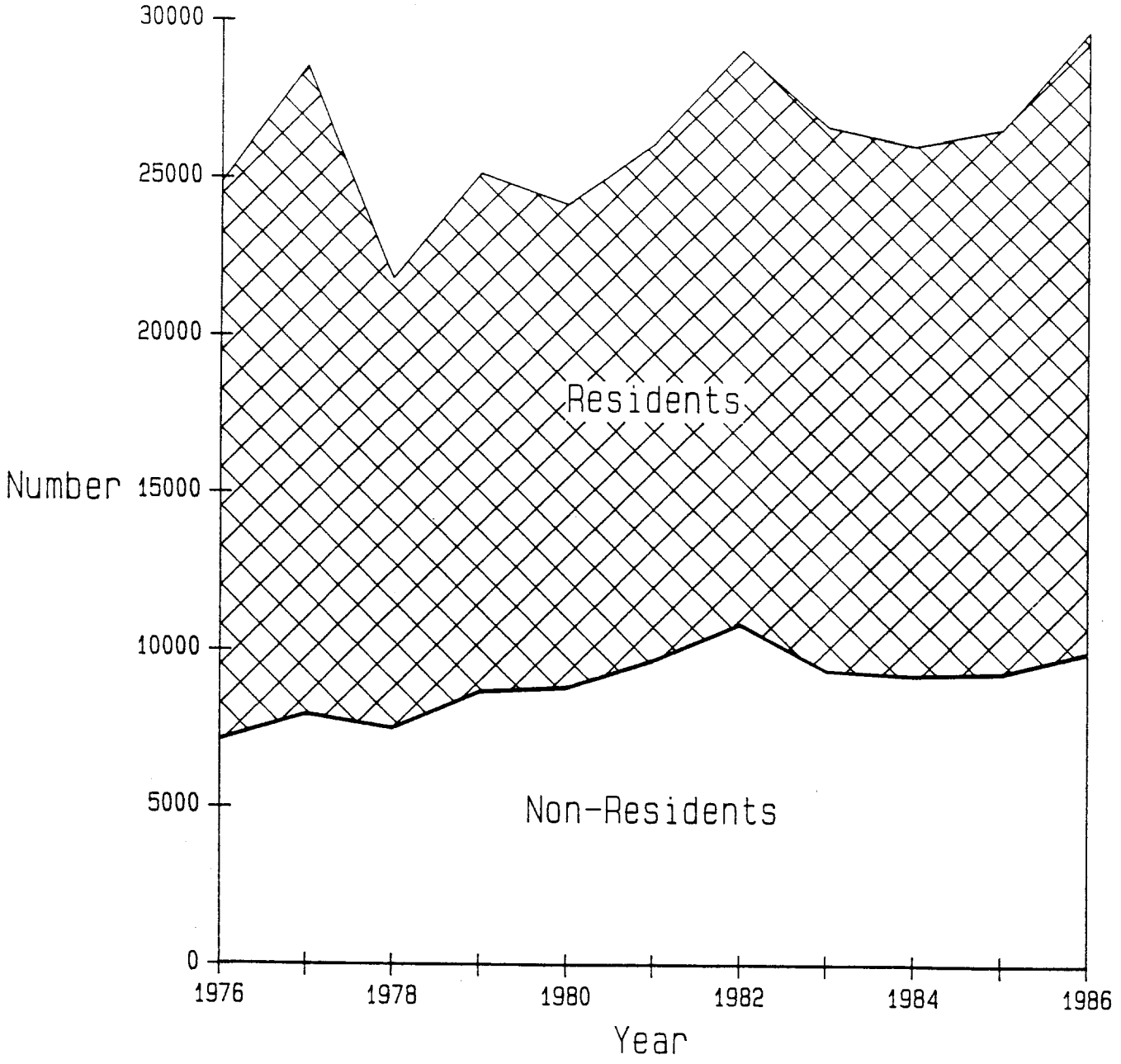

Figure 10. Number of commercial fishing crew licenses purchased by Alaska residents and non-residents in 1976-86.

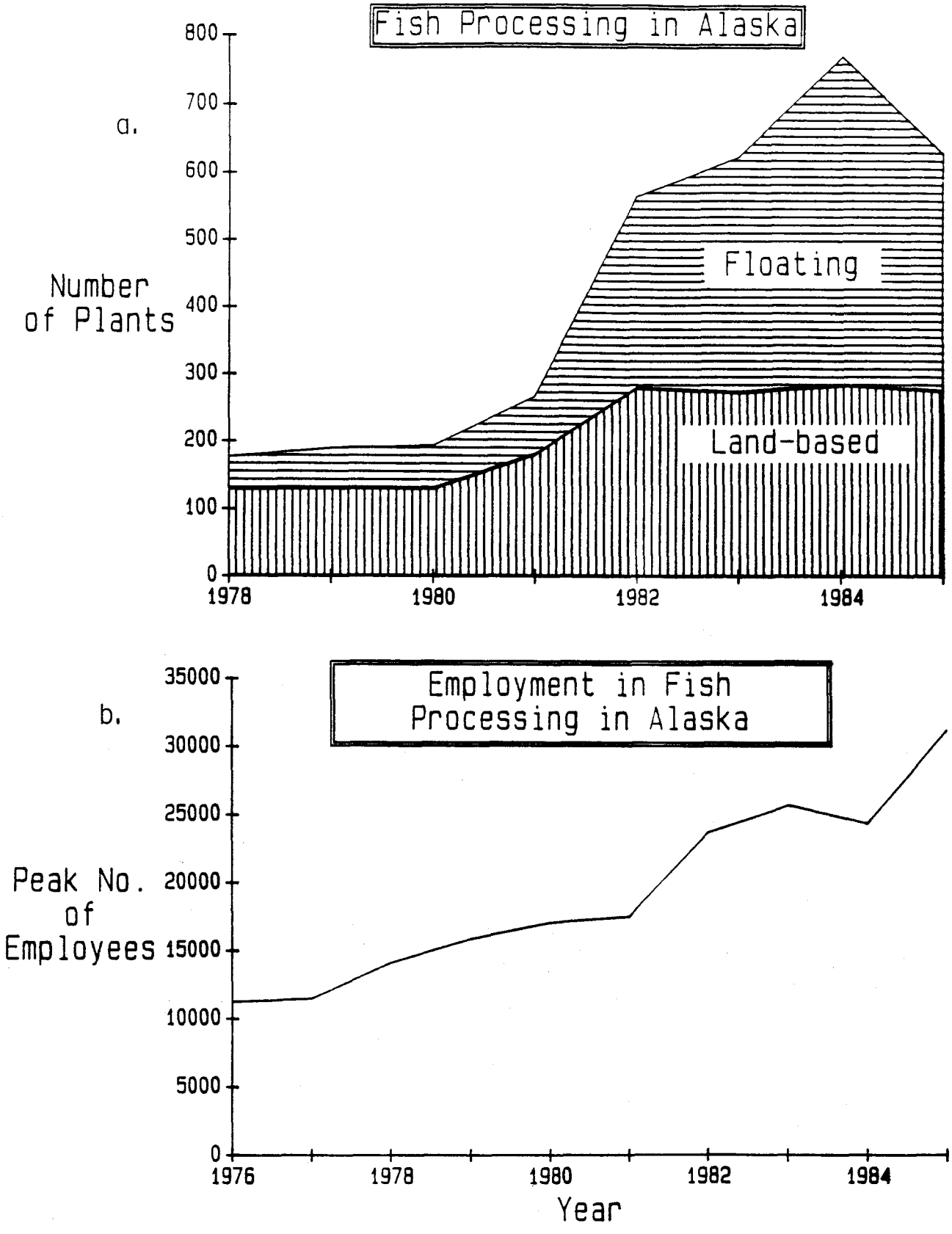

Figure 11. The (a) number of floating and land-based fish processing plants and (b) peak number of employees working in processing plants in Alaska in 1978-85.

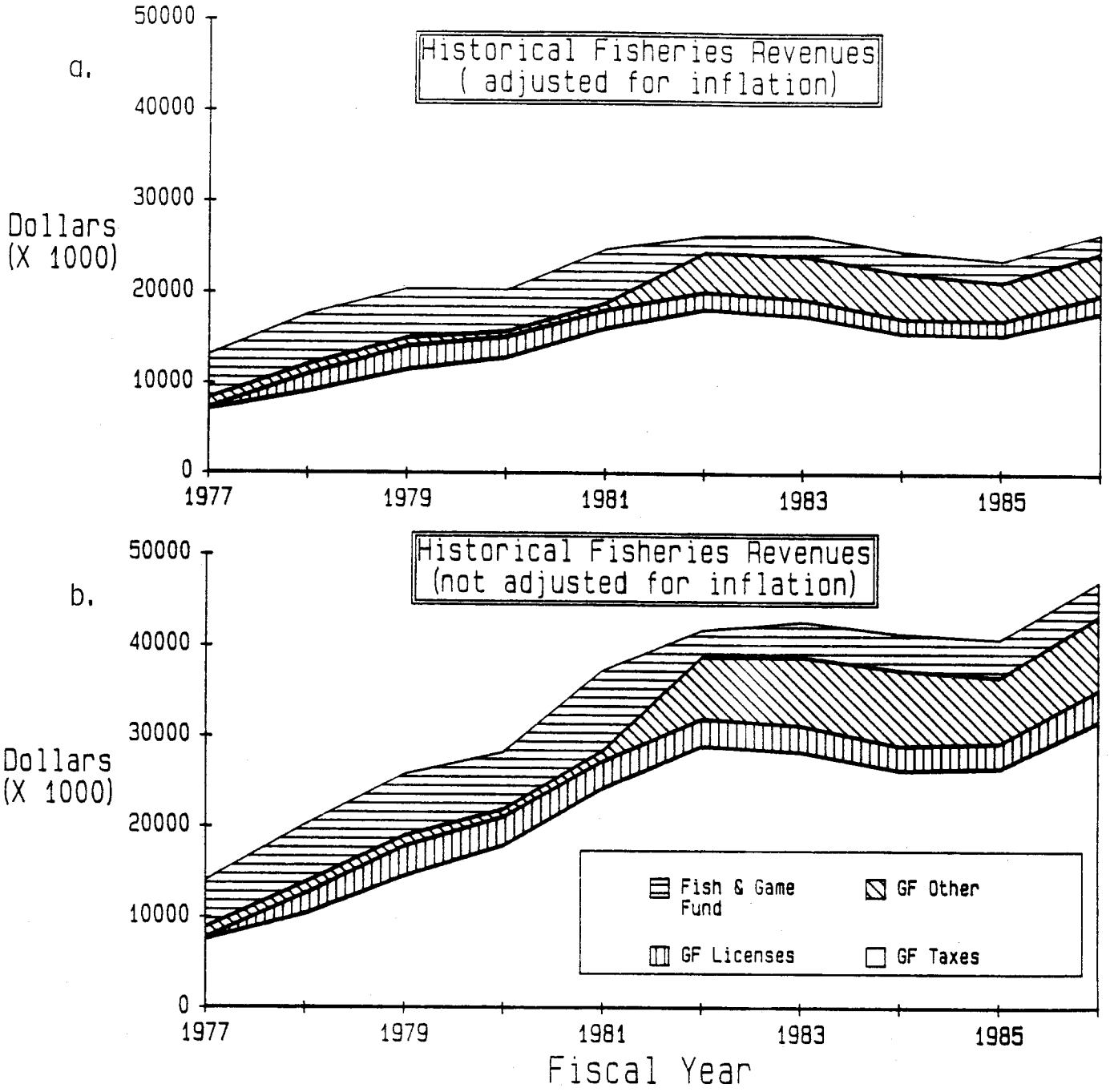

Figure 12. Historical fisheries revenues generated from fishery taxes and sales of fishing licenses and permits both (a) adjusted for inflation using the Anchorage consumer price index relative to 1976, and (b) non-adjusted for inflation over fiscal years 1977-86.

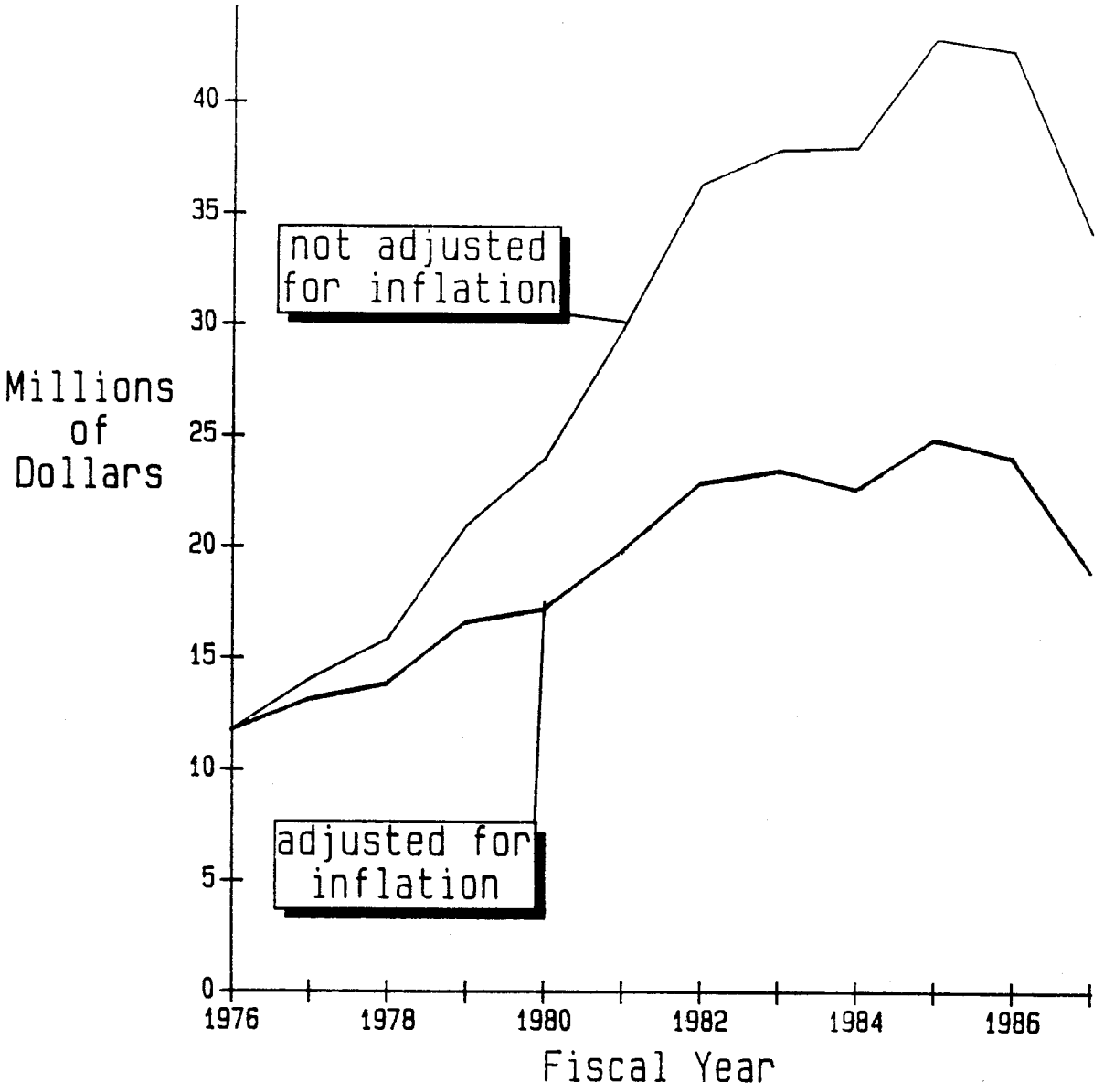

Figure 13. Estimated general fund expenditures on fisheries management by ADF&G in fiscal years 1976-87. Both inflation-adjusted (using Anchorage CPI relative to 1976) and non-inflation-adjusted figures are shown.

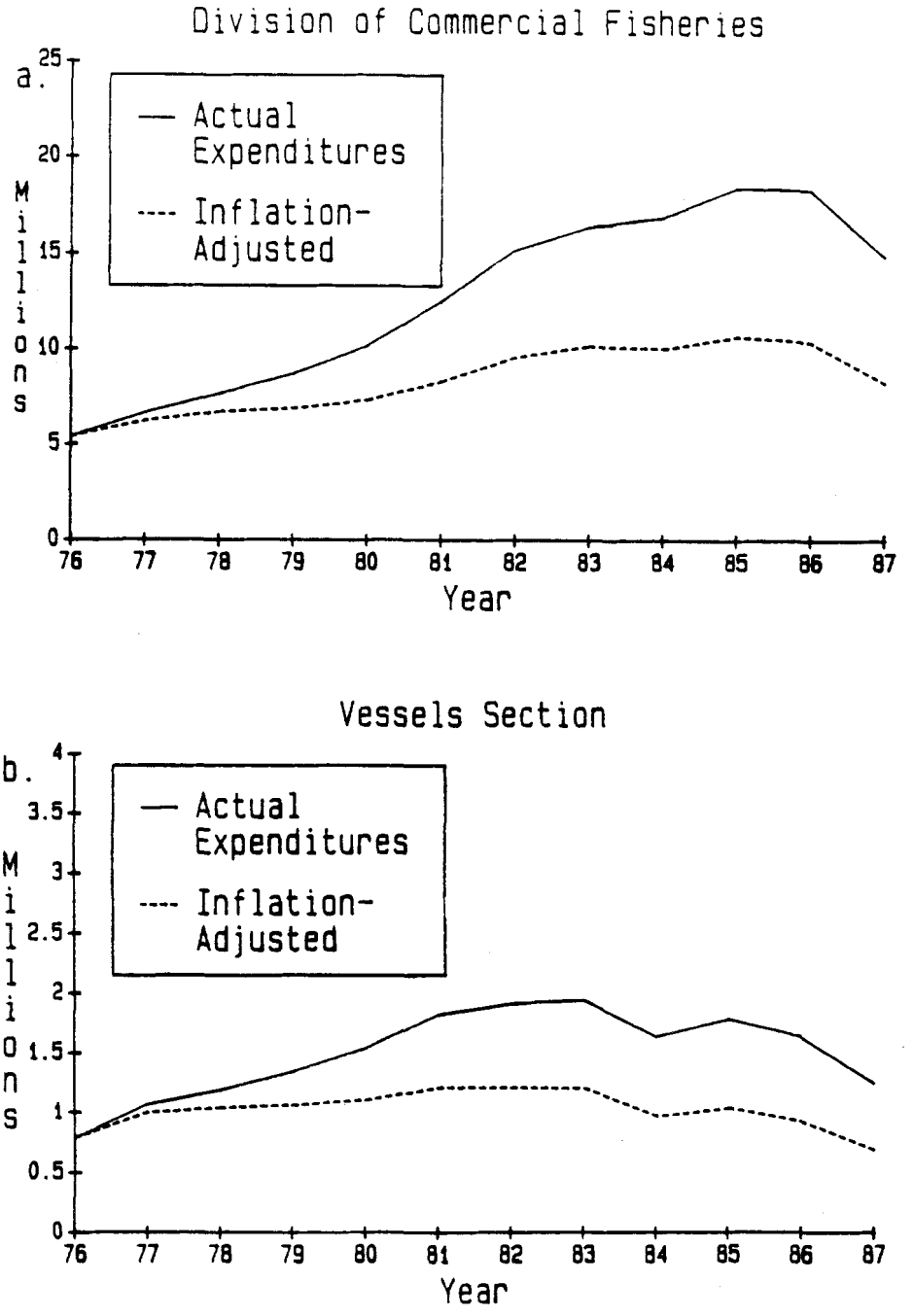

Figure 14. General fund expenditures in actual dollars and inflation-adjusted dollars (using the Anchorage Consumer Price Index relative to 1976) by (a) the Division of Commercial Fisheries (excluding Vessels Section); and (b) the Vessels Section for fiscal years 1976-87.

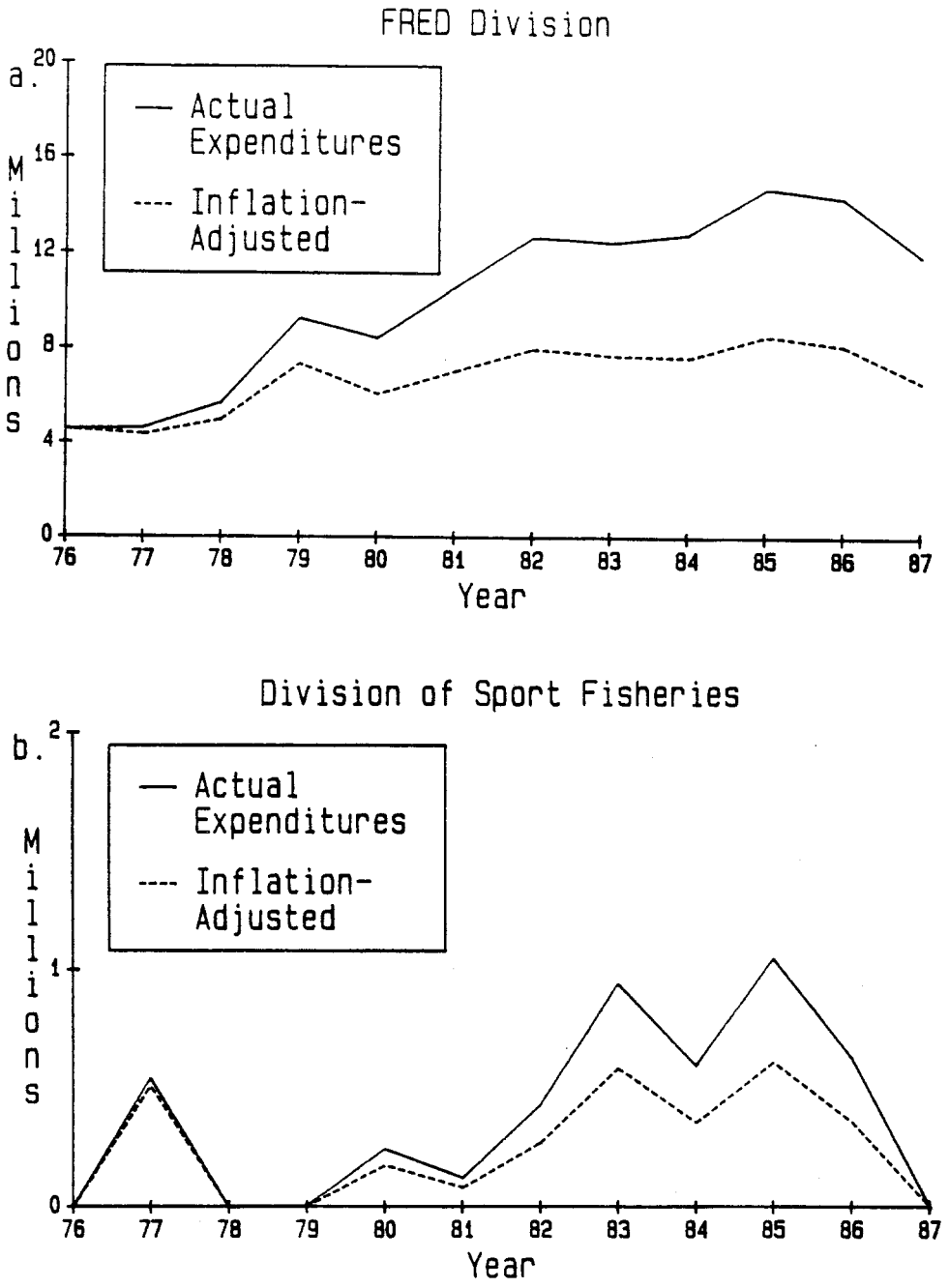

Figure 15. General fund expenditures in actual dollars and inflation-adjusted dollars (using the Anchorage Consumer Price Index relative to 1976) by the Divisions of (a) Fisheries Rehabilitation, Enhancement and Development; and (b) Sport Fisheries for fiscal years 1976-87.

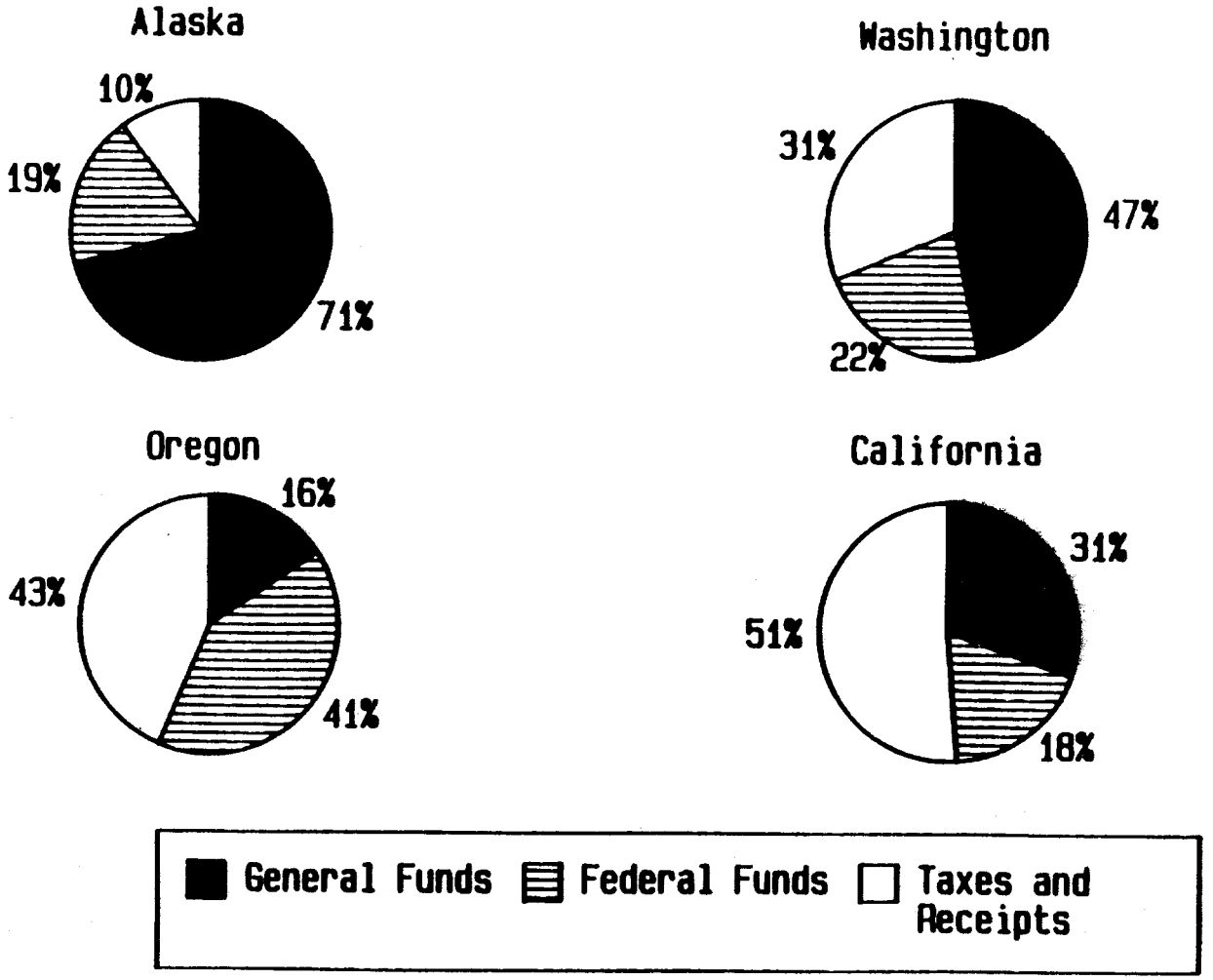

Figure 16. The budgets of the fish and game management agencies for the Pacific coast states by funding source for the fiscal years listed in Table 29.

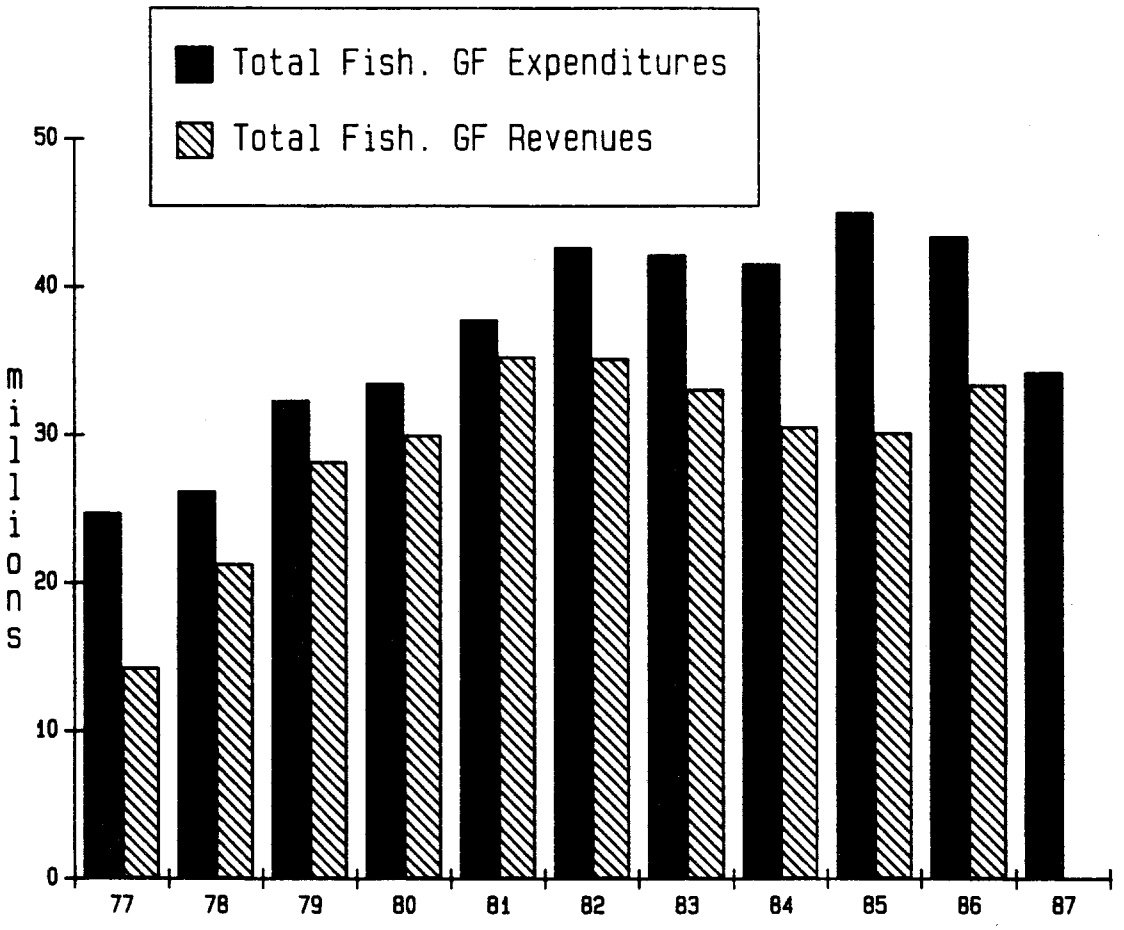

Figure 17. Total general fund expenditures for fisheries management by ADF&G versus total fisheries revenues to the general fund in 1986 dollars (adjusted by the Anchorage Consumer Price Index) for 1977-87. Revenues are total fisheries revenues minus the salmon enhancement tax, revenues from federal sources (e.g. Dingell-Johnson funds), and the Fish and Game Fund (Table 18).

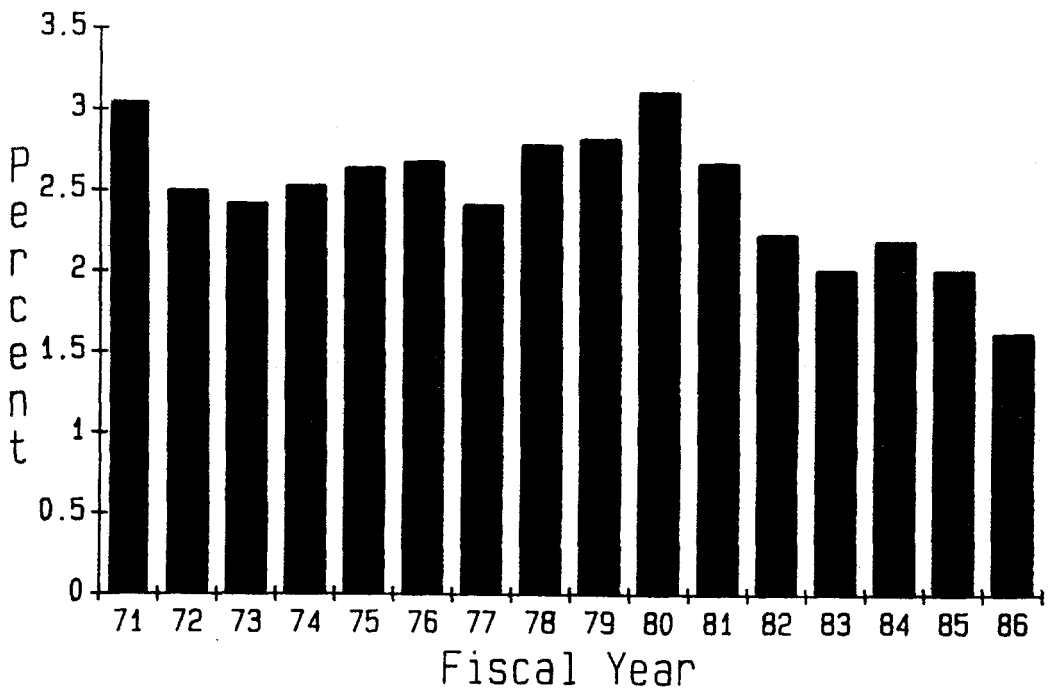

Figure 18. Percentage of the state's general fund (operating) expenditures associated with fisheries management activities by ADF&G for fiscal years 1971-86.

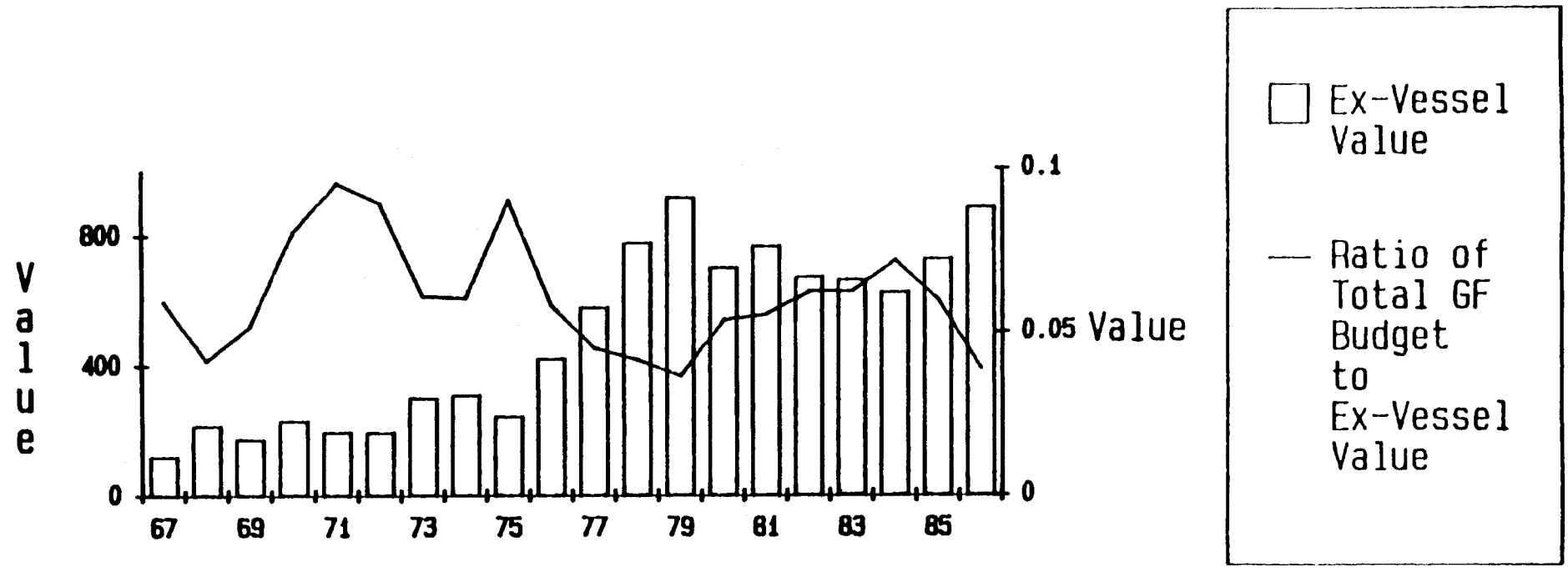

Figure 19. Ex-vessel value (millions of dollars) of commercial fisheries landings into Alaska (scale to left) and the ratio of dollars spent (total general fund expenditures) on fisheries management by ADF&G per dollar returned in ex-vessel value (scale to right). All values have been adjusted to 1986 dollars using the Anchorage Consumer Price Index.

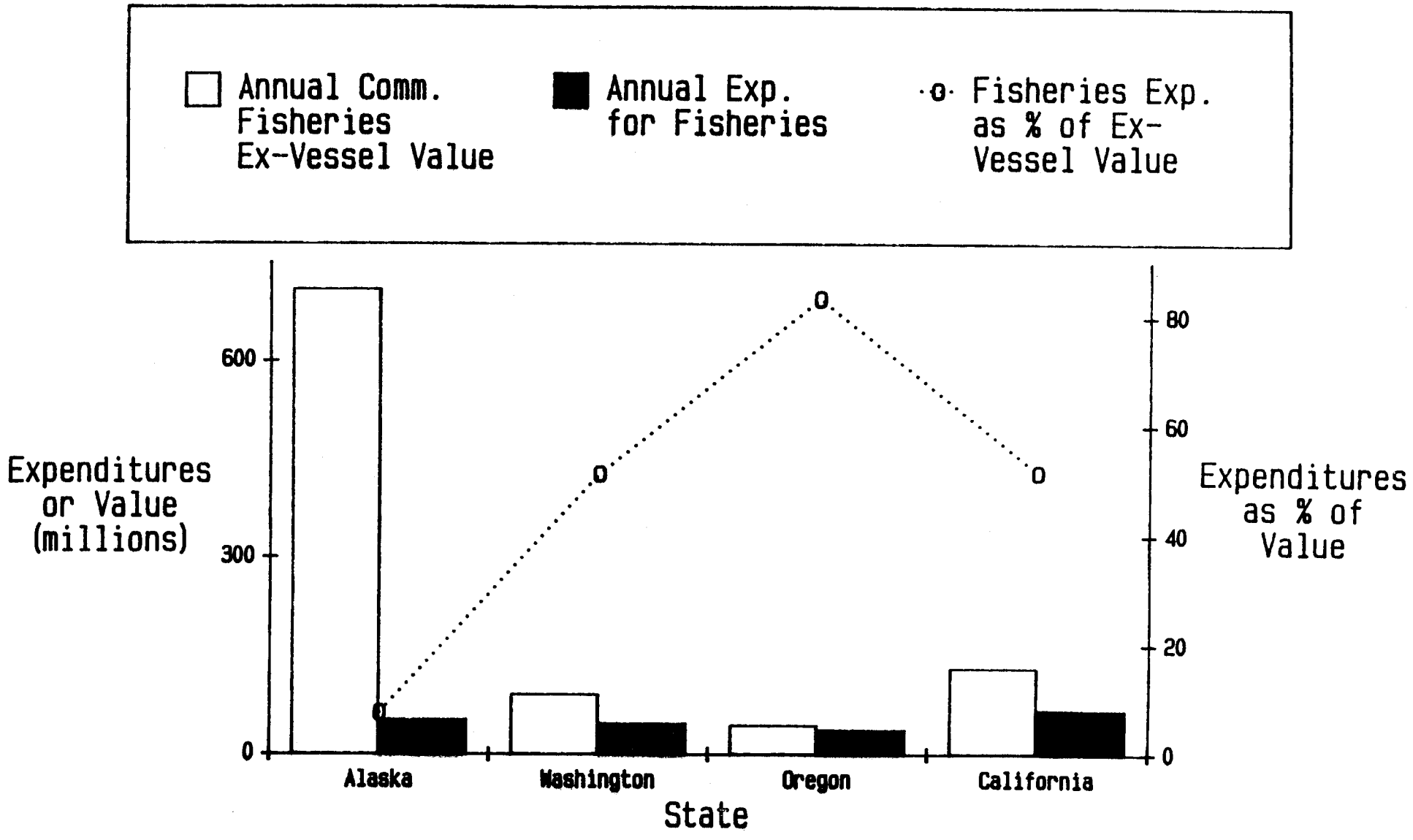

Figure 20. Annual general fund expenditures for fisheries management by state fish and game management agencies for the Pacific coast states as a percentage of ex-vessel value of landings for 1986.